

MALHEUR NATIONAL WILDLIFE REFUGE

Princeton, Oregon

ANNUAL NARRATIVE REPORT

Calendar Year 1993

| | | | |
|--------------------------|---------------|---------------------------|----------------|
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INTRODUCTION

General

Malheur National Wildlife Refuge (Malheur Refuge) is located in the Northern Great Basin Region of southeastern Oregon. Shaped like a lopsided "T", the refuge spans an area 40 miles long and 39 miles wide. At 185,540 acres it is one of the largest units in the over 500 unit National Wildlife Refuge System. Refuge headquarters, on the south side of Malheur Lake, is 32 miles southeast of the nearest town, Burns. Average elevation at headquarters is 4,112 feet above sea level.

The refuge was established by Executive Order of President Theodore Roosevelt in 1908 as an 81,786 acre "preserve and breeding ground for native birds" and was called The Lake Malheur Reservation. The 64,717 Blitzen Valley portion of the refuge was acquired in 1935 from the Eastern Oregon Land and Livestock Company under an Executive Order signed by President Franklin D. Roosevelt. The Order specified that the lands were for use "as a refuge and breeding ground for migratory birds and other wildlife". In 1940 the name was officially changed to Malheur National Wildlife Refuge. The last large segment of the refuge, 14,7512 acres in the Double-O Unit, was purchased from the William Hanley Company in 1941.

The refuge's basic habitat types are summarized below.

Table I. Habitat Types and Acreages
on Malheur Refuge.

| | |
|---------------------------|---------|
| Grass/Shrub Uplands..... | 63,380 |
| Marshes..... | 60,310 |
| Alkali Dry Lake Beds..... | 32,170 |
| Meadows..... | 25,600 |
| Croplands..... | 2,500 |
| Riparian..... | 800 |
| Admin. Sites/Roads..... | 780 |
| | <hr/> |
| | 185,540 |

Regional Setting

Since prehistoric time, the Malheur-Harney Lake Basin has been an important nesting and migration area for migratory birds (especially waterfowl), raptors, and marsh birds. Together, the refuge and the Silvies River floodplain are one of the most important migration and production areas in the Pacific Flyway.

Major Pacific Flyway concentrations of snow and Ross' geese, northern pintails, bald eagles, long-billed curlews and other shorebirds, and lesser sandhill cranes occur in the basin during the spring migration. Concentrations of lesser sandhill cranes are found primarily on the Silvies River floodplain.

Early spring waterfowl use is concentrated on the open water areas of Double-O, Harney Lake, east Malheur Lake, and the Silvies River floodplain. As more open water becomes available, the birds disperse to suitable habitat within the Basin.

Fall migration routes are similar to spring routes. A major exception is the movement of lesser sandhill cranes. They shift their route to the west, passing on the west edge of the Basin, then head southwest between Iron and Wagontire Mountains. An absence of water on the Silvies River floodplain during this period causes waterfowl use to shift dramatically to the refuge. While the recent flood and drought cycle has reduced the attractiveness of Malheur Lake for waterfowl, the refuge still serves as a major Pacific Flyway stopover for tundra swans, ducks (redheads and canvasbacks), Canada geese, shorebirds, and colonial nesting birds.

Prior to the flooding of the 1980's, Malheur Lake was used by 15 to 35 percent of the Pacific Flyway's canvasback population. Of the birds that winter in San Francisco Bay, over 35 percent have been seen on Malheur Lake at one time. As the Malheur Lake marsh was degraded by flood waters, high carp populations, and then by the effects of a six year drought, canvasback use has declined.

Malheur Refuge is a major production area on the Pacific Flyway. Before the flood, Malheur Lake was the largest, shallow, freshwater marsh in western North America. The marsh was especially important for diving ducks (redheads, canvasbacks, and ruddy ducks), colonial nesters (eared and western grebes, white pelicans, double-crested cormorants, great blue herons, great egrets, snowy egrets, black-crowned night-herons and white-faced ibis), and associated marsh and shorebirds. During and after the 1980's flood, Malheur Lake became an open-water lake habitat supporting fewer species (primarily fish eating birds and Canada geese).

Concentrations of waterfowl and waterbirds also attract bald eagles and peregrine falcons to the area during migration.

The refuge plays an important role in the production of many bird species including golden eagles, northern harriers, white pelicans, snowy plovers, American avocets, killdeer, greater sandhill cranes, American coots, cliff swallows, long-billed curlews, white-faced ibises, Franklin's gulls, bobolinks, logger-head shrikes, common yellow-throats, yellow warblers, willow flycatchers and Brewer's sparrows.

The Great Flood of the 1980's

Record snowfall and unusually cool summers from 1980 through 1986, resulted in record flows down the Silvies River, Blitzen River, and Silver Creek drainages. This caused significant damage to water management facilities in the Blitzen and Double-O units and raised the level of the Malheur-Mud-Harney Lakes system to a record high of 4102.68 MSL. The once famous Malheur Marsh was converted to open water. A flood restoration package outlines \$11.4 million of rehabilitation to be completed.

Concurrent with the rising lake levels, populations of carp exploded in Malheur Lake, further diminishing the quality of the marsh for waterfowl. Waterfowl use and production on the lakes declined drastically.

The flood affected wildlife in varying degrees. The species that depended on marsh nesting habitat (swans, rails and marsh birds), meadows (greater sandhill cranes) or alkali playa (snowy plover) were greatly impacted and the number of these species nesting in the lake units dropped to almost nil. On the other end of the spectrum, colonial-nesting birds proved very adaptable and their numbers skyrocketed. White pelicans found the small isolated islands and began nesting in 1985 on the refuge. By 1988, over 900 pelicans were being produced annually. Egrets, herons and ibis relocated on and off the refuge in smaller, scattered colonies and their numbers also increased (see the Annual Narrative Reports 1985-87). Our ability to provide good habitat conditions for key species in the Blitzen Valley and Double-O units was affected by flood damage to the water management systems.

The lakes began to decline in 1986, providing extensive mudflat habitats around their perimeters. Vegetation, consisting primarily of annual forbes, has continued to expand on mudflats. Emergent vegetation is still sparse, although cattails, burreed and hardstem bulrush continue to grow at the mouth of the Blitzen River. About 300 acres of alkali bulrush reappeared east of Cole Island Dike and small stands could also be found scattered on the west side Malheur Lake. Hardstem bulrush could also be found in small, scattered

stands on the west and north sides of the lake.

Emergent vegetation along the western side of Harney Lake provided productive habitat in the fall for canvasbacks. However, even with the sparse, new growth of emergents the lakes remain generally unproductive for waterfowl. Geese appear to be the only exception.

The Drought

Drought conditions in the late 1980's greatly reduced water levels on all three lakes. A sand ridge closed the channel between Mud and Harney Lakes in 1988, separating the two systems' surface connection. In 1991, receding water caused the disappearance of the channel, locally known as The Narrows, connecting Mud and Malheur Lakes. Dissipation of this channel completed the demise of the large lake formed by the flood waters of the 1980's. As the lakes have receded, Harney Lake has become increasingly saline, making it inhospitable for carp. Until 1992 the fresher water of Malheur Lake supported a high carp population.

At the beginning of the year Malheur Lake had a surface area of about 400 acres and was being maintained by minimal flows from the Blitzen River and Sodhouse Spring. By the end of June the lake had expanded to over 55,000 acres and water was flowing from Malheur Lake into Mud Lake. For the first time since 1989 water from Silver Creek began flowing into the refuge in late March and flows ceased by the end of May. An estimated 30,000 acre feet eventually flowed into Harney Lake. All ponds on the refuge were filled in the spring and irrigation water was available for meadows in the Blitzen Valley and at Double-O.

INTRODUCTION

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A. HIGHLIGHTS

Heavy snowpack, wet spring weather and a three day period of major runoff resulted in severe flooding at the P Ranch and Double-O substations. Sec. B and F1

A habitat management plan outlining resource problems, wildlife needs and habitat management themes for the Double-O Unit was developed. Sec. D2

Archaeological excavations take place at Site 35HA403, the Refuge Headquarters Site. Sec. D5

Water rights were given high priority. Sec. F11

Midwinter waterfowl survey shows high numbers of geese, swans, and ducks. Fall waterfowl use-days were also significantly higher. Sec. G3

Greater sandhill crane pairs increase to 230 pairs, the highest pair count since 1972. Sec. G4

Refuge visits top 48,000. New interpretive and comfort facilities are developed at Buena Vista substation. Sec. H1

Refuge staff participates in interagency cultural resources fairs in two counties. Sec. H7

B. CLIMATIC CONDITIONS

Increased precipitation and cooler temperature patterns which began in the fall of 1992 continued through much of 1993. Snow remained on the ground from the first of January until the middle of March at the refuge headquarters. This was one of the longest periods in recent history where the ground was covered with snow. Average depths ranged from almost 2 feet in the northern portion of Malheur Lake to just a few inches near the P-Ranch. Winter temperatures were well below normal with February almost 11.0°F below the 30-year average. A monthly record low of -09°F was recorded at refuge headquarters on March 1st. Snowpack on Steens Mountain was measured at over 150% of normal at the end of March, showing the heaviest snowpack since 1984.

Heavy snowpacks combined with wet spring weather resulted in major runoff in late March and early April. During a three day period in late March severe flooding occurred at the P-Ranch and Double-O substations causing both county and refuge roads to be washed out. Over seven inches of precipitation, almost 180% of the annual average, was recorded by the end of May. Malheur Lake which had dropped to a low of 400 surface acres in the fall of 1992 increased to over 40,000 surface acres by late spring. Temperatures recovered to near normal during April and May, and the May average temperature was almost 3.0°F above normal.

Storminess and below normal temperatures again returned to the region in early June. Burns, Oregon recorded its coolest July and August monthly averages since local record keeping began over 50 years ago. Temperatures recorded at refuge headquarters showed only three days in 1993 with maximum temperatures above 90°F as compared with over forty days in 1992. The wet cool weather delayed haying of many of the refuge's wet meadows until early September. Unpredictable water levels also resulted in the flooding of some duck and goose nests.

By September, a drier weather pattern took hold and continued through the end of the year. Precipitation through the last four months of 1993 was recorded at 1.68 inches or just over 50% of normal. The water year, October 1992 through September 1993, was a wet one with 13.82 inches of precipitation recorded at refuge headquarters. Normal is 9.40 inches of precipitation.

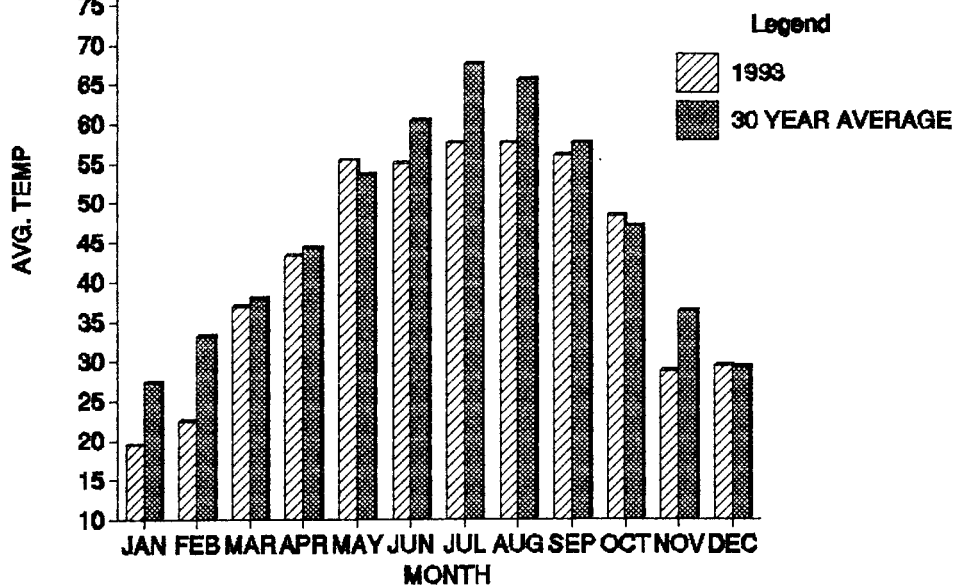
Table II 1993 Monthly High and Low Temperatures,
Precipitation, and Malheur Lake Levels Recorded
at Malheur Refuge Headquarters.

| | <u>TEMPERATURE (HO) F</u> | | | | <u>PRECIPITATION</u> | | <u>MALHEUR</u> |
|-----------|---------------------------|------|------------|------|----------------------|--------|------------------|
| | <u>HIGH</u> | | <u>LOW</u> | | <u>INCHES</u> | | <u>LAKE</u> |
| | 1992 | 1993 | 1992 | 1993 | 1992 | 1993 | <u>ELEVATION</u> |
| January | 61 | 45 | 04 | -08 | 0.14 | 1.40 | Off Gauge* |
| February | 64 | 47 | 05 | -12 | 0.64 | 0.96 | Off Gauge* |
| March | 68 | 67 | 18 | -09* | 0.55 | 2.15 | Off Gauge* |
| April | 80 | 66 | 19 | 23 | 0.88 | 1.50 | Off Gauge* |
| May | 90 | 88 | 27 | 26 | 0.19 | 1.02 | 4093.4 MSL |
| June | 95 | 91 | 32 | 30 | 1.76 | 1.59 | 4093.4 MSL |
| July | 93 | 90 | 36 | 35 | 0.24 | 0.96 | 4093.5 MSL |
| August | 97 | 88 | 27 | 34 | 0.02 | 0.43 | 4093.3 MSL |
| September | 93 | 87 | 21 | 20 | 0.20 | T | 4092.8 MSL |
| October | 85 | 85 | 21 | 18 | 1.47 | 0.89 | 4092.7 MSL |
| November | 59 | 62 | 09 | -09 | 0.84 | 0.31 | 4092.8 MSL |
| December | 47 | 61 | -05 | 08 | 1.30 | 0.48 | 4092.8 MSL |
| TOTAL | | | | | 8.23" | 11.69" | + 3.3 ft |

* Off Gauge in July 1992 at an elevation below 4089.5 MSL

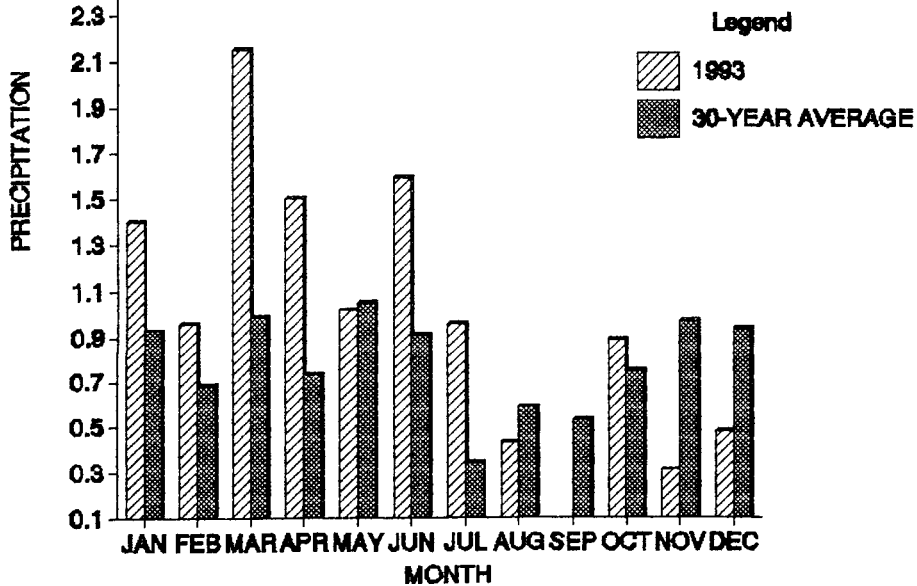
1993 MONTHLY AVERAGE TEMPERATURES VS. 30 YEAR AVERAGE

MALHEUR REFUGE HEADQUARTERS



1993 PRECIPITATION VS. 30-YEAR AVERAGE

MALHEUR REFUGE HEADQUARTERS



C. LAND ACQUISITION

1. Fee Title

In June 1993 a revised statement of acquisition priorities was submitted to the Regional Office. In addition to the purchase of the 320 acre inholding owned by Canaveri Timber Company, we listed other priorities that would enhance future management of the refuge. The Jim and Marylyn Taylor property at the south end of the Blitzen Valley is available and would allow relocation of the P-Ranch substation to avoid future threat of flood. Purchase of the Opie property on the north side of Malheur Lake would allow management and recreational access to Malheur Lake while safeguarding roost trees for eagles and colonial nesting birds. In the Sodhouse and Mud Lake area a combined trade and purchase of property owned by Rex Taylor and three Opie sisters would block up our ownership south of Mud Lake, allow us to fence the south Malheur Lake boundary on higher more stable ground, and resolve access by Taylors to several parcels of grazing land.

No progress has been made toward purchase of any of the above although all landowners are interested in discussing acquisition.

D. PLANNING

2. Management Plan

A habitat management plan for the Double-O Unit was developed in 1993. In January a four-page letter describing the goals, objectives and the basis for our management decisions was mailed to over 140 organizations and individuals. Included in the letter was a comment form to be returned to the refuge. Approximately 40 responses were received from various organizations and individuals.

In March of 1993 a preliminary draft was completed and sent out for review. The draft outlined resource problems, wildlife species needs and habitat management themes proposed for the Double-O Unit. Fifteen comments were received in response to this initial draft.

A public meeting was held on May 7 and 8, 1993 at Malheur Refuge to solicit public comment on the initial draft. Twenty individuals, representing a variety of interests, participated in discussions and on-site visits.

A final draft was mailed out for review in November. This final draft discussed the history and mission of Malheur Refuge, as well as resource challenges, wildlife management strategies and planned management actions at the Double-O Unit.

By the end of December, ten individuals submitted written comments on the plan. The Double-O Habitat Plan is scheduled for completion in the Spring of 1994 and will be implemented during the fall of 1994.

The Blitzen Valley Management Plan Habitat guidelines were again utilized during the fall and winter of 1993. This Plan, which was completed in the fall of 1990, covers the Blitzen Valley portion of the refuge. The main emphasis of this plan is to manage the refuge's habitat program (haying, grazing, burning and water level manipulation) for the benefit of migrating and breeding birds, including ducks, geese, sandhill cranes, trumpeter swans and passerines.

3. Public Participation

During 1993 an environmental assessment was completed on the proposed Interagency Interpretive Center at Frenchglen. A Finding of No Significant Impact (FONSI) was signed in June.

Refuge staff helped the Burns District BLM develop the interpretive plan for the facility. Refuge staff also developed an interagency agreement which was signed in December by the Regional Director and the BLM State Director.

The public also participated in the development of a Habitat Management Plan for the Double-O Unit during 1993. Public participation included a tour of the unit, meetings with refuge staff and other interested agencies, and the opportunity to comment on the various draft phases of the plan.

4. Compliance with Environmental and Cultural Resource Mandates

An Environmental Assessment was prepared in 1993 allowing utilization of an administrative site near Frenchglen by the Bureau of Land Management for the development of an interpretive center. After a public comment period a Finding of No Significant Impact (FONSI) was signed in June. The project is in the planning stage.

No Environmental Impact Statements were prepared during 1993. There were no Section 7, Endangered Species consultations completed.

Cultural resource surveys were conducted by refuge archaeologists for a number of refuge projects: new septic systems at the P Ranch and Double-O substations; installation of a buried phone line at headquarters, and placement of a BLM Back Country Byways information kiosk near the intersection of Diamond Lane and Highway 205. Where cultural resources were found within the proposed project areas, the projects were modified to avoid impacting archaeological sites.

Compliance with the Native American Graves Protection and Repatriation Act (1992) is a new cultural resource mandate. The Memorandum of Understanding Concerning Human Remains which was signed between the Service, the Burns Paiute Tribe and the Oregon State Historic Preservation Office fulfilled part of our obligation under this Act. However, the October 1992 reburial of all human remains recovered from Malheur Lake between 1989 and 1992 meant that all requirements of the act were completed ahead of schedule.

5. Research and Investigations

Malheur NR 81 "Color Marking of Greater Sandhill Cranes on Malheur Refuge, Oregon" - MLH-30.

The objectives and justification for this study include color marking greater sandhill cranes, which nest and stage at Malheur Refuge, to document the effects of land use practices on cranes breeding on the refuge, and to identify birds from other flocks which stage at Malheur Refuge during spring and fall migration. In 1993, 16 cranes were captured and marked. Over 380 cranes have been marked to date, providing valuable long-term data on crane ecology.

Malheur NR 86 "Study of Population Trends of Small Mammals on Malheur Refuge, Oregon" - MLH-33.

This study was initiated in 1986 by Dr. David Kerley of Eastern Oregon State College at La Grande. The purpose is to monitor long-term trends in small mammal populations in Great Basin sagebrush and greasewood shrub communities.

Since 1988 Dr. Kerley has calculated population estimates for small mammals caught in both sagebrush and greasewood trapping grids (Figure 1). The data have shown a steady decline in small mammal populations on both grids. This is mostly due to declines in the number of *Perognathus* and *Dipodomys* populations. He speculates that the decline is due to drought in recent years and poor food supplies.

Malheur NR 85 - "Effect of Early Spring Burning on Greater Sandhill Cranes (*Grus Canadensis tabida*) at Malheur Refuge, Oregon" - MLH-34.

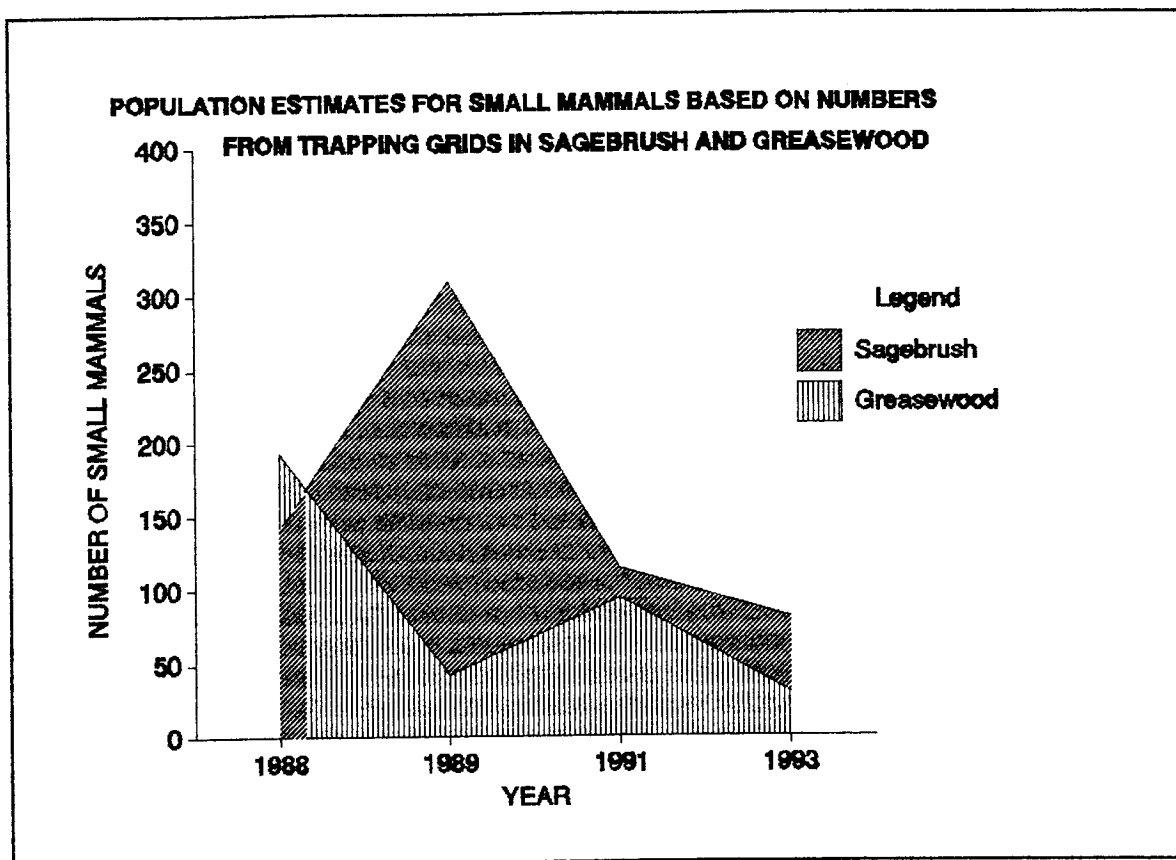
This study was initiated in 1985 by C.D. Littlefield. The primary objective is to determine how prescribed burning affects the overall nesting biology of sandhill cranes. The study is a long-term monitoring effort aimed at elevating prescribed burning as a possible tool to help the refuge reach sandhill crane production objectives. Data collection continues and no results or conclusions are available at this time.

Malheur NR 86 - "Response of *Salix exigua* to Prescribed Burning" - MLH-35.

This study was initiated in 1986 by Dr. Fritz Knopf, of the Service's National Ecology Center, Ft. Collins, Colorado. The

objectives and justification are outlined in the 1986 Narrative Report. Field data recording was completed in 1990 and final results are pending. Tentatively, fire does not appear to stimulate willow regeneration or growth at Malheur Refuge.

FIGURE 1



Malheur NR-87 - "Environmental Contaminants and Reproductive Success of Waterfowl, Stilts, and Coots at Malheur Refuge". - MLH-38.

This study was initiated by Dr. Charles Henny, of Patuxent Wildlife Research Center, Pacific Northwest Field Station, to investigate levels of contaminants in eggs of selected wetland species, and to determine if contaminants were impacting production in these species. Final results are not yet available.

Malheur NR 88 - "Effects of Land Use on Duck Pair Use at Malheur Refuge". - MLH-40.

Wildlife Biologist Gary Ivey initiated this study in 1988 to measure duck pair use on paired plots under different land use regimes. Based on preliminary analyses of data collected from 1988 through 1990, spring duck and goose use is higher on more intensively treated sites. The data also suggest that ducks shift their use of areas through the spring to take advantage of rich feeding areas, shifting from most intensively treated wetlands early to non-treated wetlands late in the breeding season. This study will be continued in 1994 if the workload permits.

Malheur NR 88 - "Willow Flycatcher Reproductive Success, Population Dynamics, and Habitat Relationships". - MLH-41.

Jim Sedgwick of the National Ecology Research Center initiated this study in 1988. The study is designed to examine the extent and causes of variation in reproductive success, and the survival, productivity, and habitat relationships of a healthy population of willow flycatchers at Malheur Refuge. Site tenacity, as related to reproductive success and habitat quality, predation, parasitism by brown-headed cowbirds, and environmental (habitat) correlates of reproductive success receive special attention. This year was the sixth year of data collection.

Results of willow flycatcher banding on three study areas in 1993 included 90 recaptures from previous years, yielding a return rate of about 58 percent. Additionally, 64 new adult birds and 185 nestlings were banded on the study areas, with another 82 birds (34 adults, 48 nestlings) banded from outside the study areas. From a sample of 127 nests, nest success was 51.2 percent. Predation and cowbird parasitism were the causes of nest failures. Cowbird parasitism was moderate this year, as cowbirds parasitized 22.8 percent of all nests, compared to 9.9 percent in 1992. Only nine cowbirds fledged, or 0.09 per willow flycatcher pair.

Malheur NR-91 - "A Radio-Telemetry Study to Identify Sandhill Crane Colt Mortality Factors. - MLH-42.

In 1991, a radio-telemetry study was initiated by Biologist Gary Ivey to determine causes of crane colt mortality while the predator control management program was in effect. This study was continued in 1992 and 1993 and will be conducted in 1994. It will provide data necessary for better future management decisions regarding production of greater sandhill cranes on the refuge.

This year's data show mortality to be 81.5 percent (five out of 27 fledged). Predation was the most important factor in colt losses during the study, with predators taking 59 percent of the study birds. Surprisingly, one pair of golden eagles was responsible for the death of four of the 27 colts in the study. Another four were killed by unidentified predators, three by coyotes, three by mink, and two by great horned owls. Only two are suspected to have died from infestation of parasitic gapeworms. One large colt moved off the refuge to an adjacent private field, where it was killed by a hay mower on July 13.

Based on study results in 1992, an experimental gapeworm dosing treatment was initiated on a sample of young cranes. This entailed giving a sample of colts a shot of Ivermectin. The preliminary results were encouraging, however, the sample size was too small to draw any firm conclusions. Only two colts found to contain gapeworms during necropsy were not given Ivermectin.

Malheur NR-91 -"Controlling Emergent Marsh Vegetation with Haystacks". - MLH-43

This study was initiated by Biologist Gary Ivey to evaluate the feasibility of using stacked hay to control emergent vegetation in refuge marshes. In January 1991, two sets of plots were established, each with a control half and an experimental half. Before the study, baseline data was collected on the plots, including plant species composition and stem densities. Emergent vegetation was mowed and raked into haystacks on the experimental areas. Preliminary data suggests this may prove to be a practical and environmentally sound emergent control technique. This study will continue in 1994 if workload permits.

Malheur NR-91 -"Reestablishment of Vegetation at Malheur Lake Following Extensive Flooding." - MLH-44

Sherry Spencer, a graduate student from Portland State University initiated this study for her Master's Thesis. The study documents plant succession on Malheur Lake's mudflats following the loss of all terrestrial plants during the high water levels of the 1980's. Flood water drowned out all marsh emergent vegetation in the lake. In 1992, the water level dropped to the lowest point in nearly 60 years. A survey of vegetation colonizing the lakeshore as flood water receded was conducted from 1989 to 1992 to describe the reestablishment of marsh vegetation.

Six transects were established in three different ecological units of the lake. Frequency and cover data for each plant species was recorded. Recruitment from seed banks produced germination the first year, mud flat species were followed the second year by perennial emergent seedlings. The emergent seedlings generally did not survive the drought as water levels continued to recede. The seeds of introduced Eurasian species were distributed by wind, became lodged in the cracks of drying mud flats and then germinated following winter rains. This pattern was seen in both the eastern and western ecological units (Unit 4 & 6). The central ecological unit (Unit 5), fed by both the Blitzen and Silvies rivers, did not show severe effects of the drought and species of emergent vegetation grew without apparent signs of drought stress.

Malheur NR 91 "Archaeological and Geomorphic Investigations of Prehistoric Sites on Malheur Lake" - MLH-45.

The third phase of an archaeological services contract with Intermountain Research, Inc., Silver City, Nevada began in August. While still emphasizing the relationship of the prehistory of the area to geomorphological processes, this year's work differed from previous years. In anticipation of construction of a proposed Interpretive Center at refuge headquarters (built in the 1930's on top of a prehistoric village site (35HA403)) preliminary excavations were conducted. The goals of this year's work were threefold: 1) to assess where location of the Interpretive Center would cause the least amount of damage to archaeological resources; 2) to clarify information gained from previous archaeological excavations in the headquarters site; and 3) to gain an understanding of how this site fit into a model (see below) of prehistoric use of Malheur Lake.



Geomorphologist Dan Dugas of Intermountain Research, Inc. examines trench walls at the Headquarters Archaeological Site, as Equipment Operator Tom Downs extends the trench northward. CB 8/93

A backhoe trench was placed near the northwest corner of the visitor's parking area. Excavation units were then placed adjacent to the trench after analyses of the trench wall to determine where the maximum amount of data could be recovered. Excavation units were also placed in the orchard, on the front lawn, below the parking area and west of the Display Pond. Extensive stratigraphic profiles were drawn for the trench and for several of the excavation units. Of special interest in the trench were beach sands and gravels indicating fluctuating high water levels (higher even than the flood of the 1980's) for Malheur Lake. A fire hearth, a trash pit filled with fish bones, and house floor were also found in the trench wall. Excavation units were placed along the trench wall to intersect with these features.



Archaeologist Jim Carter of Intermountain Research, Inc. screens dirt from an excavation unit placed in the center of the headquarters lawn. CB 8/93



Doug Blair of the refuge's firecrew brought an engine down to an excavation unit near the Display Pond to assist with water screening of dirt from one of the units. CB 8/93

Preliminary analyses of the results of this summer's work indicates that the hearth and trash pit were used at the site about 400 years ago, the house floor was in use 4800 years ago and that one high shoreline, 4113.7 ft in elevation, was as recent as 1040 years ago. It is interesting to note that this high lake level means that Malheur Lake was high enough to flow through Malheur Gap into the Malheur River. Previous investigations around the lake suggested that this had not happened since about 10,000 years ago.

Intermountain Research also completed their report for archaeological excavations and geomorphological trenching conducted in 1992 at four sites on Malheur Lake. An understanding of human use of Malheur Lake is not possible unless one knows how long the dune/islands have been available for use. Stratigraphic and archaeological data collected from trenches and excavation units at four dune/island sites (35HA2222, 35HA1899, 35HA1904 and 35HA1914) was applied to a model of dune formation and erosion that had been developed by Intermountain Research geomorphologist Dan Dugas for Harney Basin. Radiocarbon dates for 35HA1914 show that the dune formed about 800 years ago. In contrast, dune sediments at the other three sites range in age between 9000 and 2000 years. The relative ages of the four dune/islands are also reflected in the relative age of artifact assemblages recovered from the sites. Sites on eastern islands are younger than sites on northern islands. Differences in faunal assemblages are also best explained by geographical position. Rabbits are more abundant relative to muskrats in site 35HA2222, located closest to the shore, while muskrats, coots, and fish are more abundant from island sites in the lake interior.

Malheur NR 91 "Osteological Analyses of Human Remains from
Flooded Sites on Malheur Lake" - MLH-46.

Physical Anthropologist Dr. Brian Hemphill (Vanderbilt University) continued working on a final report synthesizing data collected during analyses of human remains recovered from 1989 through 1992 at sites on Malheur Lake. Dr. Hemphill's final report will cover a wide variety of topics, including: what the study of bones and teeth can tell us about diet, health, activities, death and Inter-Ethnic communications; what patterns of muscle development and arthritic affliction reveal about the habitual task activities practiced by these people; does evidence for a sexual division of labor in habitual task activities exist?; do patterns of muscle development and arthritic affliction suggest that these people tended to live rather sedentary lives, or were they highly mobile?; do we see evidence of intensive caregiving and provisioning of the sick and elderly; and a summary of osteological data acquired from the human remains.

Malheur NR-93 - "Breeding Biology of Eared Grebes at Malheur
National Wildlife Refuge." - MLH-47

This study was conducted by Dr. Wendy Hill of Lafayette College in Pennsylvania. She studied two eared grebe colonies, one at Boca Lake and the other near the mouth of the Blitzen River in Malheur Lake. Dr. Hill provided the following information in the form of an abstract of her study:

To examine nutritional levels available for young grebes, eggs were collected and egg compositions were analyzed. With increasing egg size, eared grebes increase albumin levels proportionately, but decrease the amount of yolk. Consequently, large eggs from eared grebes have relatively less yolk than small eggs, which could reduce the developmental maturity of chicks hatching from large eggs.

An additional goal of the research was to examine behavioral aspects of colonial breeding. Coloniality is an unusual type of sociality and researchers have proposed a number of hypotheses to explain why animals live in colonies. Using floating blinds to observe the birds, the advantages and disadvantages of coloniality of eared grebes were characterized. For example, while predation rates were extremely low at both the Boca and Malheur colonies, conspecific aggression was intense, especially at the Boca colony where nests were densely packed. Nearest-neighbor distances differed significantly between the two colonies, with the average distance between nests at Malheur Lake (155.3 cm) more than twice that for nests at Boca Lake (68.7 cm). As a consequence, infanticide of neighboring chicks was much greater at the Boca colony than at Malheur. This finding has implications for successful management of eared grebes as relatively open marshes may yield greater overall reproductive success for the colony because conspecific aggression and chick-killing will be lower.

E. ADMINISTRATION1. Personnel

1. Forrest W. Cameron, GM-13, PFT.....Refuge Manager
2. Dan Walsworth, GS-12, PFT.....Deputy Manager
3. Joel David, GS-11, PFT.....Ref Ops Spec (Habitat)
4. Rod A. Blacker, GS-11, PFT.....Fire Mgmt Officer
5. Gary L. Ivey, GS-11, PFT.....Refuge Biologist
6. Rick T. Vetter, GS-9, PFT.....Asst Refuge Biol
7. Carla D. Burnside, GS-11, PFT.....Refuge Archaeologist
8. Jack Richardson, GS-11, PFT.....Ref Ops Spec (Water)
(Retired 1/94)
9. Doug Staller, GS-11, PFT.....Outdoor Rec Planner
10. Selma Guthridge, GS-7, PFT.....Admin Support Asst
11. Debbie Hickey, GS-5, PFTFire Management Asst
12. Sarah Reynolds, GS-4, TFT.....Office Auto Clerk
GS-4, PFT (Promoted 8/93).....Purchasing Agent
(Resigned 11/93)
13. Jennifer Najera, GS-5, TFT.....Asst Archaeologist
GS-7, TFT.....Asst Archaeologist
14. Beth Ullenburg, GS-5, TFT.....Asst Outdoor Rec Plnr
15. Eric Scheuering, GS-5, TFT.....Biological Tech
16. Diana King, GS-1, TFT.....Clerk
GS-4, TFT.....Clerk
17. Charles Bartlemay, GS-5, PFT.....Purchasing Agent
(Resigned 6/93)
18. Paul Larson WS-11, PFT (EOD 4/93).....Maintenance Supervisor
19. Marvin L. Jess, WG-10, PFT.....Crane Operator
WS-8, PFT.....Maintenance Supervisor
(Retired 1/94)
20. Thomas E. Downs, WG-9, PFT.....Eng Equip Operator
21. John H. O'Connor, WG-9, PFT.....Maintenance Mechanic
22. Keith Henstock, WG-9, PFT.....Maintenance Mechanic
23. Pat Hickey, WG-9, PFT.....Maintenance Mechanic
24. Art Wittrock, WG-9, TFT.....Carpenter
25. Jim Vanderdasson, WG-8, TFT.....Maintenance Worker
26. Dan Sheill, GS-5, TFT.....Law Enf Officer
27. Andrew Renc, GS-6, TFT.....Lead Range Tech, Fire
28. Michael Calloway, GS-5, TFT.....Range Tech, Fire
29. Jeffrey Casey, GS-5, TFT.....Range Tech, Fire
30. Douglas Blair, GS-5, TFT.....Range Tech, Fire
31. Jeff Stenson, GS-3, TFT.....Range Tech, Fire
32. Jason Langman, GS-3, TFT.....Range Tech, Fire
33. Mike Patterson, GS-3, TFT.....Range Tech, Fire
34. Amiee Smith GS-3, TFT.....Range Tech, Fire
35. Brenda Reynolds GS-3, TFT.....Range Tech, Fire
36. John Gasioriski GS-4, TFT.....Range Tech, Fire
37. Susan Shutty.....SCA Archaeology

| | | | |
|-----|--------------------------|-----|---------------|
| 38. | Josh Hinson..... | SCA | Archaeology |
| 39. | Eric Anderson..... | Vol | Wildlife/Arch |
| 40. | Eric Scheuering..... | Vol | Wildlife |
| 41. | Eric Kelchlin..... | Vol | Wildlife |
| 42. | Gretchen Lech..... | Vol | Wildlife |
| 43. | Terry Steele..... | Vol | Wildlife |
| 44. | Maurita Smyth..... | Vol | Wildlife |
| 45. | Fred Speer, Jr..... | Vol | Wildlife |
| 46. | David Hollis..... | Vol | Wildlife |
| 47. | John Lundsten..... | Vol | Wildlife |
| 48. | Karen Kreisel..... | Vol | Wildlife |
| 49. | Kristian McIntyre..... | Vol | Wildlife |
| 50. | Marybeth Browne..... | Vol | Archaeology |
| 51. | Brandi Heinz..... | Vol | Archaeology |
| 52. | Dan Sheill..... | Vol | Outdoor Rec |
| 53. | Andy Renc..... | Vol | Maintenance |
| 54. | Margaret Hollenbach..... | Vol | Outdoor Rec |
| 55. | Patrick Hickey, Jr..... | Vol | Maintenance |



Front (left to right): F. Cameron, A. Wittrock, J. David, K. Henstock, D. Hickey, D. King, S. Guthridge, C. Burnside. Middle: R. Blacker, J. O'Connor, D. Walsworth, B. Ullenberg, P. Hickey, G. Ivey, D. Sheill. Back: J. Vanderdasson, T. Downs, R. Vetter, P. Larson, E. Scheuering.

Malheur National Wildlife Refuge 1993 Staffing Pattern

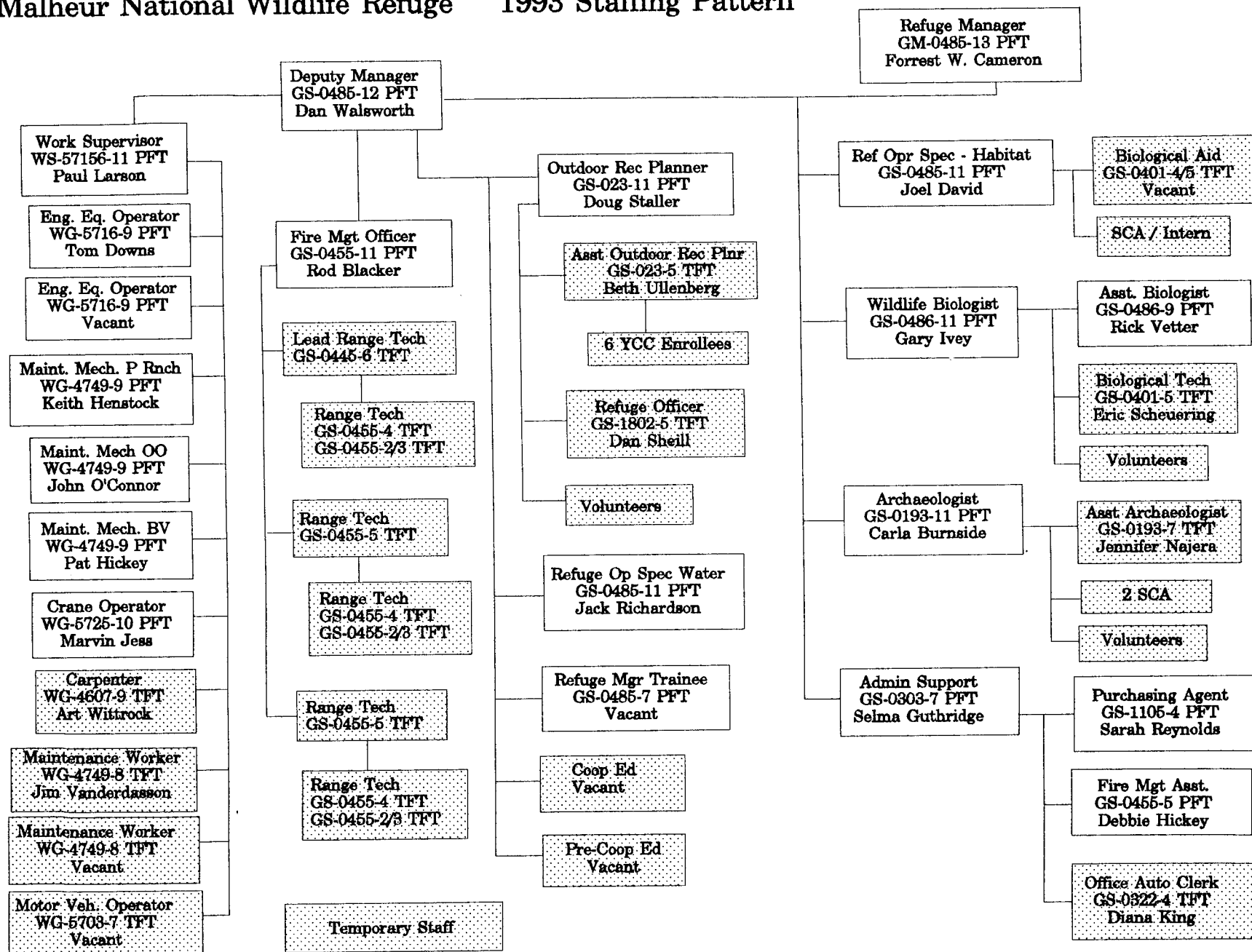


Table III. Malheur Refuge Personnel Summary, 1988-92.

| Fiscal Year | Approved Level Permanent Full-Time | Permanent Part-Time | Temporary |
|-------------|--|------------------------|-----------|
| 1989 | 17 | 0 | 3 |
| 1990 | 18 | 0 | 6 |
| 1991 | 21 | 0 | 18 |
| 1992 | 21 | 0 | 20 |
| 1993 | 19 | 0 | 18 |

2. Youth Programs

The 1993 youth program on Malheur consisted of the federally sponsored Youth Conservation Corps (YCC).

Youth Conservation Corps

The 1993 YCC program ran for eight consecutive weeks from June 17 through August 9. Outdoor Recreation Planner Doug Staller served as the program coordinator. Assistant Outdoor Recreation Planner Beth Ullenberg served as crew leader. The six enrollees were: Holly Boyles, Carolyn Chapman, Josh O'Connor, Tony Spannaus, Holly Willis, and Dan Winn.

This year's YCC crew were involved in a variety of work activities that greatly benefitted the refuge. They worked as a team to get their projects completed, taking great care in the quality of their work. Work projects included: facility maintenance, landscaping and yard work, fence construction, fence removal, habitat restoration, and building a new foot bridge at the P Ranch.

Environmental education activities included assisting with duck banding, helping with duck nest searches, assisting the archaeological crew with excavations, exploring the Bend lava caves and visiting the John Day Fossil Beds. The crew ended their busy summer with a day long canoe trip and picnic on the Blitzen River. They also prepared a scrapbook of their experiences that will be used to help orient future YCC crews to the program. The enrollees were exposed to a variety of refuge management practices and learned many new skills and environmental ethics.

Overall this season's YCC program was an excellent experience for the enrollees and the refuge. The season was very productive and the crew participated in a variety of refuge experiences. They realized no project was impossible if they worked together. Their efforts and excellent attitude were appreciated by the staff.



YCC crew members Holly Boyles and Holly Willis help SCA Susan Shutty screen dirt from the excavation behind the maintenance shop at headquarters. CB 7/93

3. Other Manpower Programs

Volunteers

During fiscal year 1993 volunteers contributed 6,800 hours of service at Malheur Refuge. Some of the highlights of the program were: river bank stabilization with juniper trees, crane telemetry, duck banding, banding and transfer of trumpeter swans, snowy plover survey, and organizing the refuge library. This year's program involved more volunteers who had a longer term commitment. These volunteers were able to do more work independently.



Volunteer Eric Scheuering with a collared trumpeter swan. GI 8/93

Student Conservation Association

Student Conservation Association (SCA) volunteers were again participants in the archaeology program at Malheur. Susan Shutty and Josh Hinson spent June, July and August working with the archaeological staff on a variety of projects. They assisted with site inventories, surveying around Boca Lake, excavations at Boca Lake and at the Headquarters Site, learned how to use an electronic total station for mapping stone ring villages at Boca Lake and collected artifacts from sites vulnerable to illegal artifact collection.



Volunteer Eric Kelchlin GI 8/93



Volunteer Gretchen Lech GI 8/93



SCA Susan Shutty and Assistant Archaeologist Jennifer Najera excavating at the Headquarters Site (35HA403). 7/93 CB



SCA Josh Hinson and volunteer Brandi Heinz in the early stages of excavating at the Headquarters Site. 7/93 CB

Table IV. Malheur Refuge Funds, 1988 - 1992.

FISCAL YEAR (FUNDS IN DOLLARS)

| FUNDS SOURCE | 1989 | 1990 | 1991 | 1992 | 1993 |
|-------------------------|---------|---------|-----------|-----------|-----------|
| 1261 BASE | | | 475,000 | 269,000 | 570,000 |
| SPECIAL PROJECTS | | | | | |
| YCC | 12,000 | 13,000 | 13,000 | 13,000 | 13,000 |
| Interpretation & Rec | | | | 39,445 | 0 |
| Fish Mgt | 24,000 | 0 | 0 | 0 | 0 |
| Challenge Grant | 3,500 | 33,000 | 125,000 | 83,000 | 67,000 |
| Vehicle Trade In | | | | 6,200 | 0 |
| Fire | 20,000 | 18,300 | 118,000 | 118,800 | 118,800 |
| Contaminants Cleanup | | | | 8,000 | 15,000 |
| Archaeology | 0 | 50,000 | 200,000 | 200,000 | 1180,000 |
| Water Rights | 0 | 0 | 0 | 0 | 50,000 |
| Coop Ed & Precoop | | | | 10,000 | 0 |
| 1261 TOTAL | 59,500 | 114,300 | 813,000 | 628,645 | 715,000 |
| 1262 BASE | 0 | 0 | 303,000 | 303,000 | 338,000 |
| MMS PROJECTS | 0 | 100,520 | 50,000 | 336,000 | 392,700 |
| 10130-1262 FENCE | | | | 40,831 | |
| 1262 TOTAL | 0 | 0 | 353,000 | 679,831 | 730,700 |
| TOTAL 126X FUNDS | 724,000 | 888,520 | 1,166,000 | 1,308,476 | 1,445,700 |
| 1121 Farm Bill Tech Ast | 0 | 0 | 30,481 | 12,000 | 10,000 |
| 1121 Farm Bill Projects | | | | 55,350 | 17,800 |
| 1230 Non Game | 0 | 0 | 7,000 | 5,000 | 2,125 |
| | | | | 62,350 | 0 |

5. Funding

Last year we reported our frustration in trying to make the RBase budget tracking program work. It is a very intricate program with complex commands. We all understand why it is the standard for tracking budgets, since you can roll up a lot of information and balance as many accounts as you want. But it is not easy to "manage" a budget of any complexity using this software. So, we switched to Lotus for its spreadsheet capability and clarity for budget managing purposes. This worked fine, almost. By mid June when it becomes imperative that we are balancing out with Denver financial printouts and fine tuning for year-end we noted that not all of our Lotus information was being converted to the Rbase program. Our conversion formula was not working and we had spent more than the Rbase records showed. This was a real blow this far into the fiscal year. We decided to go back to the Rbase program for budget tracking and dedicate the time necessary to learning it's complex commands. The risks of information loss in converting from Lotus to Rbase were just too great. Maybe next year we'll get it right! If anybody has a better idea, our phone number is (503) 493-2612.

6. Safety

Refuge fire fighters joined BLM and Forest Service fire coordinators and other fire crews for "Basic Fire Fighting" classes in Burns the beginning of June. Basic fire fighting courses, fire shelter deployment, and pumper operation training were completed at this time.

During the second week of June, YCC enrollees, along with the fire and archaeological crews, attended multimedia first-aid and CPR training at Refuge headquarters. Instruction was provided by the Burns Ambulance crew.

Periodic station safety meetings were held in conjunction with full staff meetings. The station safety committee meet to discuss and propose solutions to safety related issues. Refuge Operations Specialist (Habitat) Joel David served as committee chairperson with Assistant Biologist Rick Vetter and Mechanic Jim Vanderdasson serving as committee members. Topics discussed included vehicle equipment inspection, vehicle tire replacement, fire extinguisher inspections, eye/ear protection, and helmets for ATV's. Contaminant cleanup kits were purchased in April in case refuge staff needed to respond to chemical spills.

A new safety committee was selected in the fall with Archaeologist Carla Burnside serving as committee chairperson. Outdoor Recreation Planner Doug Staller, Maintenance Supervisor Paul Larson and Fire Crew Leader Andy Renc make up the rest of the committee.

7. Technical Assistance

Jennifer Najera, refuge archaeologist, and SCA Susan Shuttty conducted a cultural resource project clearance in August on newly acquired land at Turnbull Refuge. In September Jennifer assisted Nick Valentine, Regional Office Museum Property Specialist, with excavations at Bandon Marsh, Western Oregon Complex, in anticipation of new interpretive facilities overlooking the refuge.

Refuge Archaeologist Carla Burnside prepared a National Park Service grant for the Burns Paiute Tribe to solicit funds for a one year appointment for a tribal staff archaeologist. The tribe was awarded the grant in October. The new tribal archaeologist will be preparing a Tribal Historic Preservation Plan, guidelines for reviewing Federal Environmental Impact Statements and Environmental Assessments, and would serve as the first contact on cultural resource issues.

Biologist Gary Ivey provided recommendations to the Service's International Affairs Office regarding future cooperative programs with Chinese wildlife officials. Gary provided information to the Burns Paiute tribe on properties which may be suitable for acquisition for wildlife management. Gary consulted with the Soil Conservation Service's soil survey crew to help them add criteria useful for refuge management in their soil mapping codes. Biologists from two National Forests called on Gary for advice on sandhill crane management on their Districts. Gary also gave a tour in June to a natural resource graduate class from the University of Nevada, Reno. In July, Gary provided sandhill crane, trumpeter swan and waterfowl information for flyway records during the Pacific Flyway meeting in Reno.

F. HABITAT MANAGEMENT

1. General

Water levels in Malheur Lake rose significantly in 1993, from a low of approximately 400 surface acres in early January. Heavy spring runoff from snowpacks 150% to 170% of normal, pushed the size of Malheur Lake to over 45,000 surface acres by the end of June. By April water was flowing from Malheur Lake through The Narrows to Mud Lake. There had been no water connection between the lakes since the fall of 1991.

Emergent vegetation on Malheur Lake continued to expand in area. Because of the 1980's flooding emergent vegetation had been absent from Malheur Lake for five years and only began reappearing in 1990. Emergent growth (cattails, burreed and hardstem bulrush) continued to expand at the mouth of the Blitzen River. About 300 acres of alkali bulrush appeared east of Cole Island Dike, and small stands were also found scattered on the west side of the lake. Hardstem bulrush also appeared in small, scattered stands on the west and north sides of the lake.

Water levels in Harney Lake also increased, although changes were not as dramatic as those observed at Mud and Malheur Lakes. By late May, Harney Lake covered approximately 50,000 surface acres. Even though Harney Lake is the lowest point in the Basin it would normally have less water in it than Malheur Lake. However with the flooding of the last decade, water regimes have changed and Harney Lake is now the largest body of water in the area.

A heavy snowpack combined with a wet spring and summer contributed to a lush year in terms of vegetative growth. The Blitzen River at the south end of the refuge overflowed it's banks in mid-March, causing sheet flooding over a large expanse of ground. The water forced movement of equipment and personnel at P-Ranch to higher ground for a few days. High water also invaded the Double-O, flooding out roads, meadows and water control structures. Water running off the desert from the west remained high for several weeks at the south end of the Double-O.



Sheet flooding off of the desert created an island at the Double-O. The buildings stayed high and dry, but the roads were inundated. JO 3/93



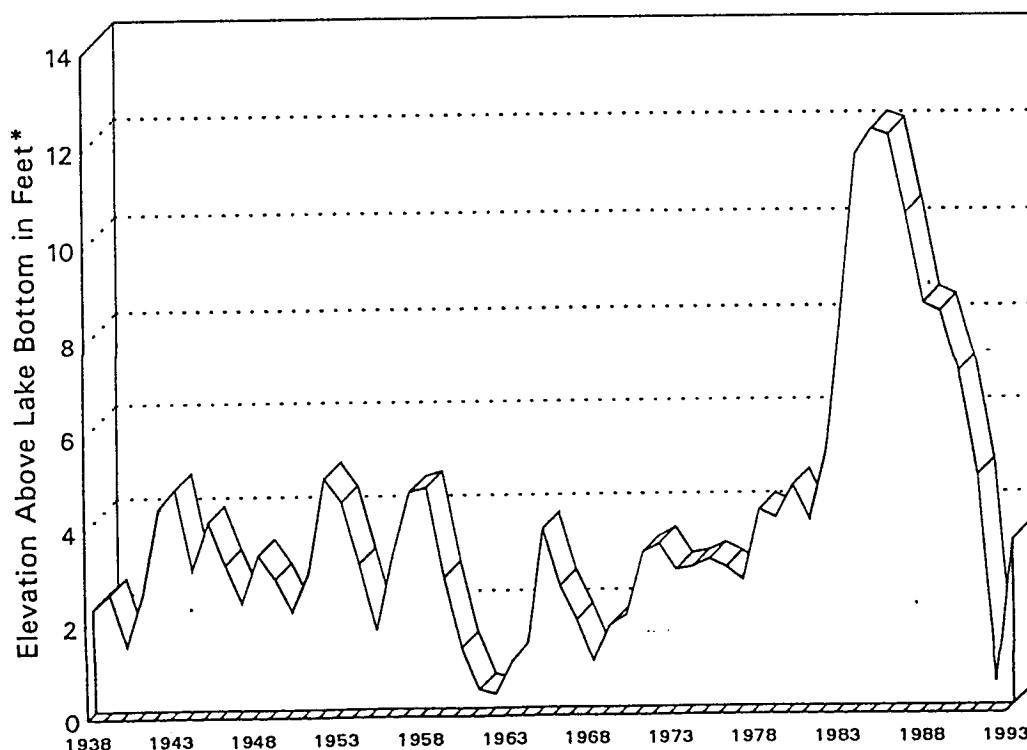
March runoff totally inundated the P Ranch, ceasing all activities at the substation and forcing evacuation of the house and barn. KH 3/93

River water was more than adequate this year to flood meadows and ponds in both the north and south Blitzen Valleys. Snow melt from Silver Creek combined with spring water provided more than adequate quantities of water for the Double-O Unit. Above average rainfall and cool temperatures continued well into August. The cool, wet weather allowed many native grasses to remain green until early September and high water levels made it difficult to hay many native grass meadows until mid-September. The standard refuge hay date is August 10th.

2. Wetlands

Because of severe drought in 1992, Malheur Lake began the year as a 400 acre body of water near the mouth of the Blitzen River. Water supplies for 1993 were 149 percent of normal on Steen's Mountain, the water source for the Blitzen Valley, and 102 percent of normal in the Silver Creek drainage which provides water to the Double-O Unit, resulting in excellent conditions for the entire refuge. This was the first time since 1989 that the Double-O received water from Silver Creek. Because of the excellent snowpack and impressive runoff, Malheur Lake rose four feet between March and the end of June covering an estimated 55,000 surface acres. Figure 2 shows Malheur Lake peak levels since 1938.

FIGURE 2 Peak Water Levels of Malheur Lake, 1938 - 1993.



* Assuming Malheur Lake bottom at elevation of 4090.5' MSL.

With higher water levels, emergent vegetation appeared around the shoreline and in a fairly extensive area near the mouth of the Blitzen River. Ninety-five percent of the lake was open water.

Aquatic plant surveys were conducted in most major ponds in the Double-O and Blitzen Valley units between August 4th and September 10th. Survey data for refuge ponds are summarized in Table V. Most pond ratings improved, as there were higher concentrations of aquatic plants, fewer carp and increased use by waterfowl. Two main factors affected the overall improvement in the quality of ponds this year; the end of a six year drought and substantially lower carp numbers. Water levels returned to normal in most ponds with the exception of Dune Pond which had a washed out dike and Cottonwood Pond which was drained before the surveys were initiated. In contrast, seven ponds were dry during 1992 because of drought conditions.

Overall quality ratings of the ponds were as follows: 21 percent excellent, 50 percent good, 17 percent fair, 25 percent poor, and 8 percent dry. Quality ratings are defined in the Malheur Refuge Wildlife Habitat Inventory Plan. Overall quality ratings were the highest in recent years. In 1993, 71 percent of ponds rated excellent or good, compared with only 23 percent in 1992, 50 percent in 1991, 41 percent in 1990 and 47 percent in 1989.

Comparing carp indices from the 22 ponds surveyed in 1993 to previous indices shows 55 percent (12) of the ponds had fewer carp, 32 percent (7) had no change, and 14 percent (3) had more carp. A closer analysis of the 12 ponds with improved indices indicates that 83 percent (10) of these improved to the best level - "no carp".

The 1993 aquatic plant acreages for Malheur and Harney lakes were estimated during fall aerial surveys: Malheur Lake had an estimated 10,000 acres of sago pondweed, while Harney Lake had 12,000 acres of widgeongrass. Two major sago pondweed beds were located in Unit 5; the first was just east of the mouth of the Blitzen River on the south side of Malheur Lake, and the other was south-southeast of the mouth of the East Fork of the Silvies River on the north side of Malheur Lake. In 1992, Malheur Lake contained only three acres of aquatic plants. This dramatic change in Malheur Lake is due to the elimination of approximately 80,000 carp between Malheur Lake and Sodhouse Dam on the Blitzen River. As very few carp remained to inhibit aquatic plant beds, the biggest problem for aquatic plant growth was the severe wind fetch in the vegetation-barren central portion of the lake where turbidity presumably prevented regrowth.

Table V Summary of Aquatic Plant Survey Data Collected from Ponds on Malheur Refuge in 1993.

| UNIT | POND NAME | QUALITY RATING | AVERAGE CLARITY(cm) | DOMINANT* VEGETATION | CARP INDEX** |
|--------------------------------|----------------|-------------------|-----------------------------|-------------------------|-----------------|
| 1 | Warbler Pond | poor | 50 | POPE/ZAPA | 1 |
| 1 | Derrick Lake | fair | 30 | POPE | 3 |
| 1 | Martha Lake | fair | 90 | MYEX | 1 |
| 1 | Tule Pond | fair | 6 | HIVU/ZAPA | 1 |
| 7 | Pintail Pond | poor | 46 | POPE/RAAQ | 3 |
| 7 | Wright's Pond | excellent | 160 | POPE | 1 |
| 8 | Unit 8 Pond | fair | 45 | POPE/MYEX | 3 |
| 8 | E. Buena Vista | good | 57 | POPE/MYEX | 1 |
| 8 | W. Buena Vista | good | 57 | POPE/ELNU | 1 |
| 9 | Skunk Farm | excellent | 87 | POPE/CHVU | 1 |
| 9 | Unit 9 | excellent | 89 | POPE | 1 |
| 9 | Diamond Swamp | good | 20 | POPE/URVU | 2 |
| 10 | Krumbo Swamp | poor | 28 | MYEX/POPE | 1 |
| 10 | Witzel Pond | excellent | 54 | POPE/PONO | 2 |
| 11 | Boca Lake | poor | 50 | algae | 2 |
| 11 | Benson Pond | excellent | 32 | POPE/RAAQ | 2 |
| 11 | Dredger Pond | good | 50 | POPE | 2 |
| 11 | Jones Pond | poor | 49 | ELAC/POPE | 1 |
| 12 | Rail Pond | good | 85 | POPE/RAAQ | 2 |
| 12 | W Knox Pond | good | 55 | POPE/RAAQ | 1 |
| 12 | E Knox Pond | good | 73 | POPE | 1 |
| 12 | Darnell Pond | fair | 30 | POPE | 3 |
| * VEGETATION ABBREVIATIONS: | | | ** CARP INDEX: | | |
| POPE= Potamogeton pectinatus | | | 1= No carp | | |
| PONO= Potamogeton nodosus | | | 2= Few carp | | |
| MYEX= Myriophyllum exalbescens | | | 3= Moderate carp numbers | | |
| ZAPA= Zannichella palustris | | | 4= High carp numbers | | |
| URVU= Utricularia vulgaris | | | 5= Carp up to our elbows | | |
| RAAQ= Ranunculus aquaticus | | | ELNU= Elodea nuttalli | | |
| CHVU= Chara Vulgaris | | | ELAC= Eleocharis acicularis | | |

Table VI summarizes estimates of aquatic plant acreages for major refuge ponds and for the lakes. In 1993 the total estimated acres of aquatic plant beds was 23,331 (22,000 acres in the lakes, 185 acres at Double-O, and 1,146 acres in the Blitzen Valley). Submergent plant acreages (Table VI) for the lakes, Double-O and the Blitzen Valley all increased over 1992 acreages. The increase was due to a combination of the 1992 carp control efforts and excellent water supplies.

Table VI Estimated Acreages of Submergent Plants in Major Ponds within Each Biological Unit at Malheur Refuge, During Aquatic Plant Surveys, 1988-93.

| BIOLOGICAL UNIT | ACRES OF SUBMERGENTS | | | | | |
|--------------------|----------------------|------|------|-------|--------|--------|
| | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
| 1 | 41 | 83 | 35 | 9 | 24 | 185 |
| 2 | 0 | 0 | 0 | 5,000 | 15,000 | 12,000 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4-5-6 | 0 | 0 | 0 | 15 | 3 | 10,000 |
| 7 | 105 | 122 | 70 | 21 | 0 | 127 |
| 8 | 37 | 82 | 195 | 330 | 70 | 363 |
| 9 | 15 | 58 | 45 | 80 | 0 | 180 |
| 10 | 44 | 26 | 27 | 37 | 63 | 46 |
| 11 | 129 | 128 | 243 | 261 | 219 | 163 |
| 12 | 105 | 203 | 78 | 117 | 2 | 267 |
| TOTAL | 476 | 702 | 693 | 5,870 | 15,331 | 23,331 |

1993 Pond Management Actions:

Dry Ponds

All ponds were filled in the spring with excellent runoff water supplies. Dune Pond at the Double-0 and Cottonwood Pond near P-Ranch were both dry by August.

Carp Control

Carp were controlled using drawdowns in Carp, Dune, Willard, and Rodeo Ponds in the Double-0; East Buena Vista, Coot, S-Curve, Unit 8 Ponds and McLaughlin Slough in the Buena Vista area; and Benson, West Swamp, Jones, Dredger, Knox, Rail, Cottonwood, and Bridge Creek Ponds in the P-Ranch area. Carp were controlled with rotenone in Bridge Creek, McLaughlin Slough, Center Canal in the Larson Field, West Canal and Cow-Pie Pond in the P-Ranch Unit.

Burned Ponds

Coot Pond in the Buena Vista Unit was burned in early March to improve marsh interspersion. Snow Goose Pond in the Double-0 was burned in March to facilitate dike repair.

4. Croplands

The refuge's grain program is geared towards fall maintenance of greater sandhill crane populations. Sandhill cranes stage at the refuge in September and October before heading south to the Central Valley of California. This was the first year the refuge used force account farming to plant 250 acres of grain. Approximately \$5000.00 was spent in each of the past two years to contract out planting operations. Prior to that the services of a cooperative farmer were used, but with little success.

Barley grain was obtained from Klamath Basin Refuge in early April. Discing and planting continued from mid-April through mid-May using newly purchased Case 9320 and 5740 tractors with implements. Although planting used a lot of staff time, the outcome of over 70 percent of the plants reaching maturity was worthwhile.

The refuge also completed approximately 70 acres of annual rye plantings in the Grain Field at the Double-O using force account labor. Unfortunately, water sat on this field for an extended period during the spring causing loss of the crop.

5. Grasslands

For the purposes of management at the refuge, grasslands are divided into two basic habitat types: uplands and meadows.

Uplands

Uplands are defined as those areas where Great Basin wildrye, sagebrush and their associated species dominate the vegetative composition at ecological climax. These areas are managed for wildlife by providing periodic treatment to insure vigorous plant growth and to maintain residual nesting cover. The primary treatment involves prescribed burning on a 10 year frequency followed by non-use.

The habitat monitoring and classification program has made it possible to identify current and potential habitat conditions and to monitor trends in habitat condition for 23,300 acres of uplands in the Blitzen Valley. Results show that overall cover conditions have improved significantly in uplands over the past 15-20 years. Uplands are providing cover at or near their potential in about 90 percent of the Blitzen Valley. Habitat monitoring in the spring of 1993 showed that upland conditions in a majority of refuge fields are stabilized. Drought conditions which were prevalent during the past six years caused a cover deficit in some uplands. One such area is located around the North Meadow A and the East House

Fields. Portions of the native meadows in these sites are hayed while the uplands remain idle. During the past year, optimum upland cover conditions in those fields declined, in spite of idle management treatment. It is anticipated that the current change in weather patterns will result in improvements to upland cover.

The status of high potential uplands in fields where upland nesting cover is a management priority is identified in Table VII. The Percent of Potential figure shows what percent of the uplands in these fields are providing the maximum amount of residual nesting cover. For example, a figure of 50 percent indicates that half of the uplands are providing optimum cover, while a value of 100 percent shows that all of the uplands are at their potential for providing nesting cover. With little time between snow melt and field flooding, only about one-half of the refuge's fields were monitored in 1993 for upland cover.

The Double-O, Harney and Malheur Lake Units have not yet been inventoried and classified under this system. Based on general observations, the condition of upland cover in the Double-O area is summarized in Table VIII. A management plan is being developed for this unit and will be used to correct any problems which may exist with upland habitat.



Upland nesting cover in the Blitzen Valley. JD 4/93

Table VII Current Status of High Potential Uplands, Blitzen Valley.

| FIELD | ACRES | HIGH POTENTIAL UPLAND ACRES | % AT HIGH POTENTIAL | | TREATMENT 1993 |
|---|-------|-----------------------------------|------------------------|------|-------------------|
| | | | 1992 | 1993 | |
| Coyote Butte | 1119 | 154 | * | * | Idle |
| West River | 60 | 25 | * | * | Idle |
| Thoroughbred | 735 | 319 | * | 100 | Idle |
| N.W. Big Sage | 4127 | 1424 | 90 | 100 | Idle |
| Center Sage | 2718 | 572 | 28 | 0 | LRBG |
| Rockford Lane | 2474 | 607 | * | 53 | Idle |
| N.E. Wright | 265 | 38 | * | * | Idle |
| W. Wright | 1111 | 461 | 88 | 100 | HO |
| S. Wright | 1899 | 347 | * | | Idle |
| W.E. Big Sage | 1385 | 188 | 23 | 80 | Idle |
| E.E. Big Sage | 2047 | 648 | * | * | Idle |
| Little Sagebrush | 1393 | 429 | * | 11 | Idle |
| U-8 Duck Pond | 1345 | 201 | * | | Idle |
| Jenkins | 700 | 322 | 35 | 59 | Idle |
| N. Meadow A | 280 | 48 | 100 | 39 | HO |
| N. Meadow B | 413 | 101 | 98 | 93 | RBG\SAF |
| E. House | 129 | 15 | 66 | 23 | HO |
| Oliver Springs | 1167 | 152 | * | 0 | Idle |
| Skunk Farm | 932 | 91 | 93 | 0 | LRBG |
| Krumbo Reservoir | 894 | 69 | * | * | Idle |
| N. Boca Lake | 265 | 23 | * | * | Idle |
| S.U. Bridge Crk | 578 | 57 | * | * | Idle |
| Big Dry | 835 | 77 | 100 | 100 | HO |
| Knox | 606 | 118 | * | * | Idle |
| Knox #5 | 199 | 125 | * | * | Idle |
| N. Little Junip. | 684 | 142 | 100 | 100 | HO |
| S. Little Junip. | 521 | 44 | 85 | 79 | Idle |
| Island | 808 | 91 | 100 | 99 | HO |
| W. Big Juniper | 493 | 145 | 92 | * | HO |
| E. Big Juniper | 81 | 18 | * | * | RBG |
| Barley | 212 | 27 | 93 | * | HO |
| Big Deer Park | 942 | 116 | * | 100 | HO |
| TOTAL | | 31,417 | 7,164 | | |
| Treatment Types | | | | | |
| Idle - No use for at least one growing season | | | | | |
| HO - Hay only | | | | | |
| RBG - Rake Bunch | | | | | |
| LRBG - Light Rake Bunch Graze | | | | | |
| GO - Graze Only | | | | | |
| SAF - Stack and Feed | | | | | |
| * - Uplands not monitored in 1993 | | | | | |

Table VIII General Cover Conditions of Uplands in the Double-O Unit.

| Field | Acres | Treatment | General Cover Conditions |
|--|-------|-----------|--------------------------|
| Peterson | 773 | Idle | Poor |
| Rock Island | 620 | Idle | Poor |
| Plow | 320 | Idle | Fair |
| Grain | 367 | SAF | Fair |
| North Chappo | 1483 | Idle | Fair |
| South Chappo | 495 | Idle | Fair |
| N. Stinking Lake | 410 | Idle | Fair |
| Stinking Lake RNA | 1500 | Idle | Fair |
| Redhouse | 678 | HO-SAF | Fair |
| Martha Lake | 2972 | Idle | Excellent |
| West Freeman | 432 | GO | Poor |
| East Freeman | 833 | Idle | Poor |
| Cow Pasture | 458 | Idle | Excellent |
| Willard | 456 | HO/RBG | Fair |
| Hughett | 364 | HO/RBG | Fair |
| Upper Swamp | 255 | RBG | Fair |
| Yriarte | 502 | RBG | Poor |
| Lower Swamp | 2348 | GO | Fair |
| Treatment Types | | | |
| Idle - Non-use at least one growing season | | | |
| HO - Hay Only | | | |
| RBG - Rake Bunch Graze | | | |
| GO - Graze Only | | | |
| SAF - Stack and Feed | | | |

Meadows

Meadows include the zone between upland sites and emergent marshes where moist, sub-irrigated or seasonally flooded soils favor the production of grasses, rushes, sedges and water-tolerant plant species. A variety of treatments are conducted on the meadows (hay, grazing, idle and prescribed burning) to provide diverse conditions for wildlife. Treatment intensity is the primary factor used to monitor meadows. Treatment intensity is defined as the percentage of biomass removed or damaged in relation to pre-treatment conditions.

Under the Blitzen Valley Management Plan, meadows are managed to provide treatment at an intensity of 60 percent removal of meadow vegetation on 60 percent of the meadow area. Table IX provides a summary of treatments applied to meadows in the Blitzen Valley and Double-O during the 1992/93 season.

Table IX Acreage and Percentage of Meadow Treatments in the Blitzen Valley and Double-O Units, Malheur Refuge.

| TREATMENT INTENSITY | ACRES | PERCENT |
|--|---------|---------|
| Idle (no use) | 14,564 | 51.0 |
| Graze Only (light use) | 3,493 | 12.0 |
| Rake-Bunch Graze | 6,061 | 21.0 |
| Hay Only | 3,753 | 13.0 |
| Prescribed Burn | 728 | 02.0 |
| TOTAL | 28,599* | 100.0 |
| (* Difference from total figure reported in the 1992 narrative reflects addition of the Double-O Unit) | | |

6. Other Habitats

Woody riparian zones are managed to provide optimum conditions for a multitude of species including red-band trout, willow flycatchers and other songbirds. Management includes efforts to protect these areas from disturbance and promote healing of areas previously disturbed.

The habitat monitoring program shows that riparian zones are currently in good condition and are improving in virtually all sections of the Blitzen Valley.

Stream habitat enhancement work has been carried out along the Blitzen River near P-Ranch for the sixth year through a cooperative effort with Trout Unlimited, the Oregon Department of Fish and Wildlife (ODFW), and Oregon Trout. This year's work involved placement of 120 feet of juniper rip-rap and rock jetties to stabilize stream banks and promote recovery of riparian vegetation. (See section G-11)

With the help of YCC enrollees and the Outdoor Recreation Staff, willows, cottonwoods, aspen and other riparian species were planted along stream banks in areas of the Double-O, P-Ranch, Witzel Corral and Benson Boat Landing. Orchards at P-Ranch, Warm Springs, and refuge headquarters were pruned, cleaned and new trees planted with the help of the YCC enrollees.



Volunteers and the Refuge's Firecrew place juniper rip-rap along the Blitzen River. JD 8/93

7. Grazing

In the 1992/93 season, a total of 21,196 Animal Unit Months (AUMs) of forage were removed by grazing. This is a twenty percent decrease over the 1991/92 season level of 26,335 AUMs and a thirty-one percent decrease over the 90/91 level of 30,464 AUMs. This year's decrease can be attributed to drought conditions during the 1992 growing season. With implementation of the Blitzen Valley Management Plan, refuge grazing AUM rates should average around 26,000. During the 1992-93 season, 42 fields (20,269 acres) were grazed or about 11 percent of the total refuge acreage of 185,000. No grazing took place during the growing season.

Rake-bunch grazing is a treatment strategy used to create open shallow flooded areas for early season waterfowl pairing and feeding habitat. Meadows are cut in August when protein levels are at about 8-10 percent. This vegetation is then raked into bunches and left until mid-winter when cattle graze these bunches of higher quality forage. Adjoining uplands are not supposed to be impacted, since the protein levels in these areas are much lower than in the rake-bunches. However, we have seen that impacts to uplands can occur during harsh winters when forage consumption is greatly increased, and in

mild winters when fall rains and warmer weather cause regrowth of upland grasses. Our planning assumption had been that if only 60% of the meadow forage is allocated during an average year, livestock impacts are minimal in adjacent upland cover and willow riparian habitat.

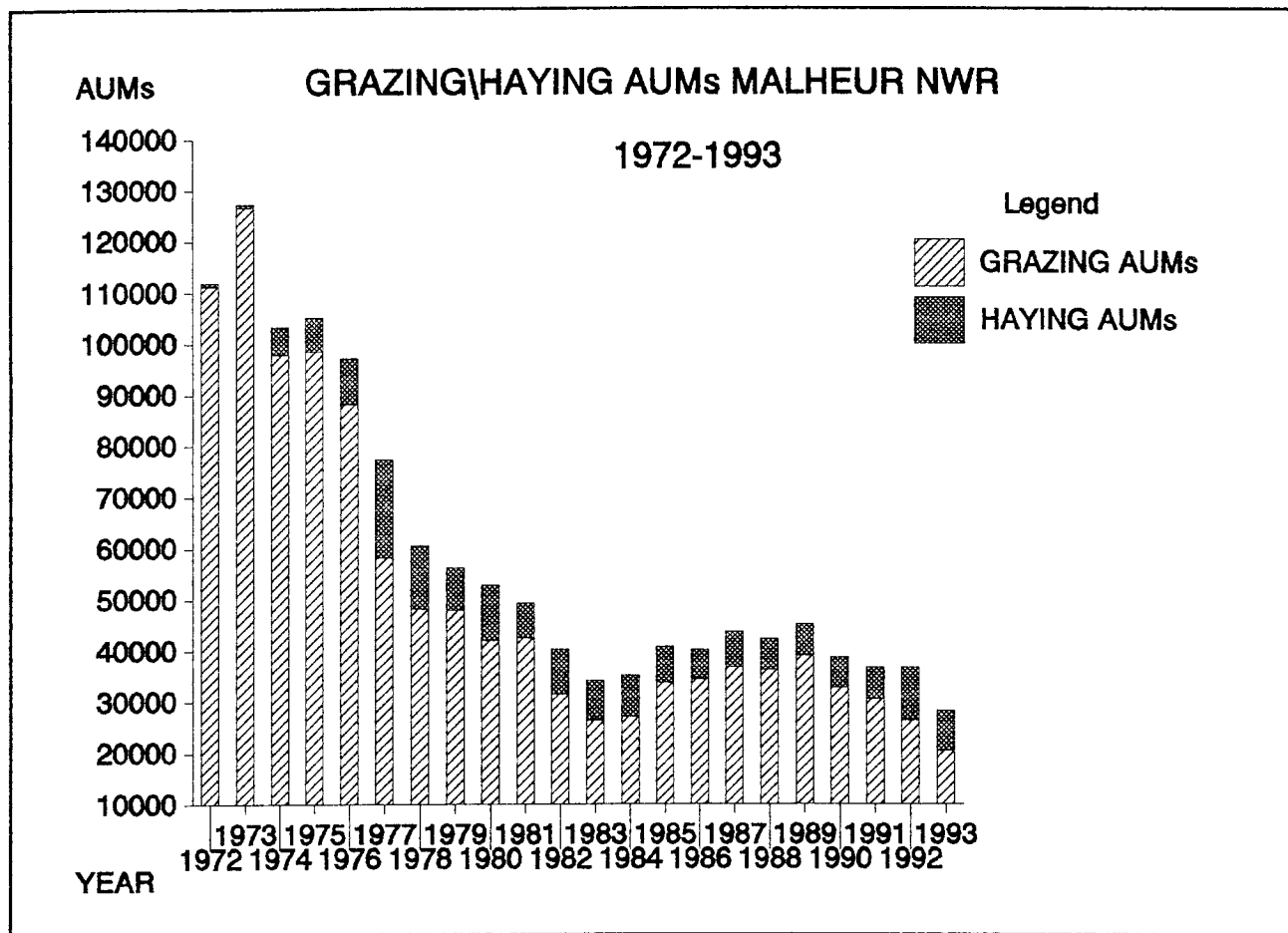
Biomass production on refuge meadows averages about 2,800 pounds per acre in a normal year, but can range from 800-4500 pounds per acre per year depending on annual moisture. About 85 percent of this biomass is usable as livestock forage when a rake-bunch graze treatment is applied. Using the standard AUM figure of 800 pounds of forage, it follows that a treatment which allows for three AUMs per acre grazing intensity would remove 2400 lb of forage on a meadow site. Table X summarizes the grazing treatments in refuge fields during the 1992-93 grazing season. Treatment intensity is expressed in AUMs per acre. Figure 3 summarizes the total AUM use on the refuge since 1972.

Fields with a grazing intensity below 0.5 AUMs/acre generally contain significant areas of nesting uplands or willow riparian habitat. Grazing intensities greater than 1.0 AUM/acre are applied to broad flat fields with extensive emergent marshes that require some treatment by livestock to create open water areas for waterfowl pairing habitat. Grazing intensity was lowest (0.4 AUMs per acre) in the Center Sagebrush, Dredger #1 and Upper Krumbo Fields. These fields are either crested wheat grass fields or have large uplands interspersed with wet meadows. The most intensively grazed field on the refuge was the East Big Juniper Field (6.8 AUMs/acre). This field was rake-bunch grazed to provide wildlife feeding and pairing areas. In addition, hay that was cut and baled on adjacent fields, where protection of uplands and riparian habitat is critical, was fed on this field to provide greater treatment impacts to dense, overgrown stands of cattail and bulrush. This area is surrounded by idle fields which provide excellent nesting cover.

Table X Summary of Grazing Treatments and Intensity on Malheur
Refuge Fields During the 1992-93 Grazing Season.

| Field Name | Treatment | Acres | AUMs | AUMs/ Acre |
|--|-----------|-------|-------|---------------|
| Grain | SAF | 367 | 250 | 0.7 |
| West Freeman | RBG | 432 | 463 | 1.1 |
| Upper Swamp | RBG | 255 | 1116 | 4.4 |
| Yriarte | RBG | 502 | 588 | 1.2 |
| Willard | RBG | 300 | 341 | 0.9 |
| Hughett | RBG | 244 | 523 | 2.1 |
| S. Sodhouse | RBG | 382 | 650 | 1.7 |
| N. Sodhouse | RBG | 579 | 700 | 1.2 |
| Lower Swamp | GO | 2347 | 251 | 0.1 |
| Center Sagebrush | RBG | 2718 | 1018 | 0.4 |
| South Center | RBG | 200 | 218 | 1.1 |
| N. Meadow B | RBG | 414 | 484 | 1.2 |
| Larson | RBG | 437 | 563 | 1.3 |
| Suicide | RBG | 296 | 660 | 2.2 |
| Rimrock | RBG | 577 | 683 | 1.2 |
| Skunk Farm | GO | 933 | 960 | 1.0 |
| Lava Swamp | GO | 629 | 557 | 0.9 |
| Retherford Lake | RBG | 960 | 575 | 0.6 |
| Tipton | GO | 367 | 458 | 1.2 |
| West Center | RBG | 273 | 289 | 1.0 |
| N. Swamp | RBG | 704 | 734 | 1.0 |
| East Center | RBG | 160 | 210 | 1.3 |
| Witzel | RBG | 156 | 427 | 2.7 |
| Lower Krumbo # 1 | RBG | 157 | 546 | 3.5 |
| Lower Krumbo # 2 | RBG | 101 | 134 | 1.3 |
| Upper Krumbo | GO | 233 | 100 | 0.4 |
| South Krumbo # 2 | GO | 178 | 115 | 0.6 |
| Dredger #1 | GO | 779 | 324 | 0.4 |
| Bailey | GO | 382 | 350 | 0.9 |
| West Swamp #2 | GO | 287 | 219 | 0.8 |
| Jones | RBG | 759 | 1343 | 1.8 |
| South White | RBG | 379 | 518 | 1.4 |
| Warm Springs | RBG | 291 | 875 | 3.0 |
| E. Big Juniper | RBG/SAF | 239 | 1631 | 6.8 |
| Faye | RBG | 650 | 745 | 1.1 |
| West South Meadow | RBG/SAF | 427 | 903 | 1.1 |
| N. Meadow | RBG | 414 | 425 | 1.0 |
| N Knox #4 | GO | 43 | 75 | 1.8 |
| S Knox #4 | GO | 27 | 50 | 1.9 |
| TOTALS: | | 20269 | 21196 | 1.0 |
| HO = Hay only RBG = Rake-Bunch-Graze GO = Graze Only SAF = Stack and Feed | | | | |

Figure 3



8. Haying

Haying is used as a management strategy when it is desirable to provide mowed meadow conditions, but it is necessary to protect adjacent uplands and riparian zones. Under this treatment the permittee is required to cut, bale and remove the vegetation. Most haying is accomplished in early August. The amount of forage removed using this strategy has remained fairly constant over the past five years, between 2400 and 3500 tons removed per year. Table XI shows tons of hay removed in the last five years. Table XII summarizes the haying program for the 1992-93 season.

Table XI Summary of Actual Forage Removed by Haying in
the Last Five Seasons.

| PERMIT TYPE | 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 |
|---------------------|---------|---------|---------|---------|---------|
| Regular Hay Tons | 513 | 532 | 2,501 | 3,428 | 3,031 |
| HCEFP Hay Tons | 1,957 | 1,856 | 0 | 0 | 0 |
| TOTAL HAY TONS | 2,470 | 2,388 | 2,501 | 3,428 | 3,031 |

Table XII Summary of Hay Removal by Field for 1992/93
Season.

| FIELD NAME | ACRES TREATED | TONS REMOVED | TONS /ACRE |
|-------------------|------------------|-----------------|---------------|
| Hughett | 120 | 150 | 1.25 |
| Willard | 156 | 92 | 0.63 |
| Yriarte | 150 | 100 | 0.66 |
| N. Meadow A | 161 | 15 | 0.10 |
| South Center | 153 | 212 | 1.38 |
| House | 335 | 331 | 1.01 |
| W. Grain Camp | 125 | 158 | 1.26 |
| M. Grain Camp | 105 | 94 | 0.89 |
| Lower Krumbo #1 | 120 | 94 | 0.78 |
| Lower Krumbo #2 | 080 | 50 | 0.62 |
| Lower Krumbo #3 | 100 | 100 | 1.00 |
| Baker | 500 | 150 | 0.30 |
| Big Dry | 557 | 351 | 0.63 |
| N. Little Juniper | 198 | 140 | 0.71 |
| Bridge Creek | 438 | 450 | 1.02 |
| Island | 333 | 369 | 1.10 |
| Barley | 100 | 115 | 1.15 |
| Warm Springs | 022 | 056 | 2.54 |
| TOTALS: | 3753 | 3031 | 0.80 |

9. Fire Management

The snowpack at the end of February was about 131% of normal in eastern Oregon. By August 4 precipitation was 111% above normal. As a result of these conditions the 1993 Malheur Refuge fire season started with two Bureau of Land Management (BLM) wildfire assists on August 4th and 7th and continued through a November 3rd Vale District wildfire assist.

Refuge crews responded to 30 fire incidents and took action on 6 wildfires and 23 prescribed burns. Of these, no wildfires and 21 prescribed burns were on Malheur Refuge. A total of 1,222 acres were burned on Malheur Refuge.

The refuge aided the Burns District BLM on 3 wildfires (3,095 acres) and private landholders adjacent to the refuge on 3 wildfires (90 acres). They also responded to a false alarm as an interagency resource (Table XIII).

Malheur deployed the following resources to regional suppression efforts:

- ▶ 5 engine assignments for a total of 10 days
- ▶ 1 prescribed burn assignment for 5 days (2 engines & 4 people)

The prescribed burn crew went to Finley Refuge near Corvallis, Oregon and assisted in burning 2 units: 80 acres in the Research Natural Area to set back succession in the native prairie ecosystem; and 45 acres of agricultural fields to remove grass and provide a seed bed for farming operations. Air quality is a major factor in the prescribed burning operations at Finley. A north or northwest wind that blows the smoke south or east over Eugene or Interstate 5 results in the Oregon Department of Environmental Quality (DEQ) prohibiting or shutting down all burning. When a northeast wind blows the smoke towards the ocean, the DEQ allows a short time window of 2-4 hours to start and complete all burns. This usually occurs between noon and 4 pm. Steady northeast winds were present this year during all our burning, but we had to wait until 5 pm on one day before burning could begin.

Malheur Refuge prescribed burned 21 units totaling 1222 acres (Table XIV) in 1993. We had no problems with smoke management or peat fires this year. Fire improved sandhill crane and waterfowl habitat on the burn units, while also benefitting other species.

MALHEUR REFUGE WILDFIRES

| YEAR | # WILDFIRES | TOTAL ACRES BURNED | AVE. SIZE (AC.) | LARGEST FIRE (AC.) |
|--------------|-------------|--------------------|-----------------|--------------------|
| 1984 | 2 | 82 | 41.0 | 80 |
| 1985 | 3 | 2354 | 784.7 | 1754 |
| 1986 | 2 | 426 | 213.0 | 425 |
| 1987 | 0 | 0 | 0.0 | 0 |
| 1988 | 1 | 0.5 | 0.5 | 0.5 |
| 1989 | 8 | 1156 | 144.5 | 640 |
| 1990 | 4 | 3395 | 848.8 | 3200 |
| 1991 | 5 | 813.3 | 162.7 | 663 |
| 1992 | 3 | 1102 | 367.3 | 900 |
| 1993 | 0 | 0 | 0.0 | 0 |
| TOTAL | 28 | 9328.8 | 333.2 | 3200 |

MALHEUR REFUGE PRESCRIBED BURNS

| YEAR | # PRES. BURNS | TOTAL ACRES BURNED | AVE. SIZE (AC.) | LARGEST FIRE (AC.) |
|--------------|---------------|--------------------|-----------------|--------------------|
| 1984 | 1 | 960 | 960.0 | 960 |
| 1985 | 4 | 5973 | 1493.3 | 5500 |
| 1986 | 5 | 2470 | 494.0 | 1200 |
| 1987 | 10 | 3729 | 372.9 | 1600 |
| 1988 | 11 | 3074 | 279.5 | 1100 |
| 1989 | 9 | 2015 | 223.9 | 600 |
| 1990 | 4 | 478 | 119.5 | 300 |
| 1991 | 8 | 1529.2 | 191.2 | 978 |
| 1992 | 8 | 1351 | 168.9 | 683 |
| 1993 | 22 | 1223.5 | 55.6 | 425 |
| TOTAL | 82 | 22802.7 | 278.1 | 5500 |

MALHEUR REFUGE FIRES *

| YEAR | # FIRES | TOTAL ACRES BURNED | AVE. SIZE (AC.) | LARGEST FIRE (AC.) |
|--------------|------------|--------------------|-----------------|--------------------|
| 1984 | 3 | 1042 | 347.3 | 960 |
| 1985 | 7 | 8327 | 1189.6 | 5500 |
| 1986 | 7 | 2896 | 413.7 | 1200 |
| 1987 | 10 | 3729 | 372.9 | 1600 |
| 1988 | 12 | 3074.5 | 256.2 | 1100 |
| 1989 | 17 | 3171 | 186.5 | 640 |
| 1990 | 8 | 3873 | 484.1 | 3200 |
| 1991 | 13 | 2342.5 | 180.2 | 978 |
| 1992 | 11 | 2453 | 223.0 | 900 |
| 1993 | 22 | 1223.5 | 55.6 | 425 |
| TOTAL | 110 | 32131.5 | 292.1 | 5500 |

* Prescribed & Wildfires Combined

Table XIV Prescribed burns by Malheur refuge fire crews in 1993.

| DATE | UNIT | Ac. Burned | PURPOSE |
|---------|------------------|------------|--|
| 2Feb93 | BV Ditch | 1 | Maintenance |
| 6Mar93 | Hughett | 60 | Maintenance |
| 6Mar93 | Sodhouse | 0.1 | Brushpile |
| 31Mar93 | N. Coot Pond | 425 | Waterfowl |
| 10Jun93 | P-Ranch 1 | 0.1 | Brushpile |
| 11Jul93 | Headquarters | 0.1 | Brushpile |
| 18Jul93 | Witzel | 0.1 | Brushpile |
| 19Jul93 | P-Ranch 2 | 0.1 | Brushpile |
| 20Jul93 | Stubble | 0.1 | Brushpile |
| 15Aug93 | Kado 1 | 0.1 | Brushpile |
| 16Aug93 | Grain Camp | 0.1 | Brushpile |
| 17Aug93 | Kado 2 | 5 | Maintenance |
| 29Aug93 | Volunteer | 0.1 | Brushpile |
| 9Sep93 | Kado 3 | 2 | Maintenance |
| 27Oct93 | Grain | 300 | Waterfowl |
| 28Oct93 | Plow | 225 | Waterfowl |
| 28Oct93 | Peterson | 200 | Waterfowl |
| 2Nov93 | S. Cole Is. Dike | 2 | Maintenance |
| 3Nov93 | N. Cole Is. Dike | 1 | Maintenance |
| 6Dec93 | Bass Springs | 0.1 | Brushpile |
| 6Dec93 | P-Ranch 3 | 0.1 | Brushpile |
| TOTAL | Malheur Refuge | 1,222.1 | ACRES BURNED |
| 19Oct93 | N. RNA FINLEY | 80 | Set back seral stage; eliminate shrubs. |
| 20Oct93 | Finley Field 29 | 45 | Farm field prep; provide fertile seed bed. |
| TOTAL | W. OR Refuges | 125 | ACRES BURNED |
| TOTAL | All Rx Burns | 1347.1 | ACRES BURNED |

Interagency agreements with the BLM have enabled the refuge to use the closest forces concept during initial attack of fires on or next to the refuge. The Burns BLM dispatch assigns refuge crews to off-refuge interagency fires. The dual agency Frenchglen Fire Station has improved response time for both agencies on the south end of the fire district. Shared costs of this facility has also benefited both agencies.

The 3,000 gallon septic tank for the refuge's fire trailers was pumped out during the summer. It was last pumped out 15 years ago. The fire trailers are getting old, need major repairs (siding blowing off, roof leaks, etc.), and should be surplused soon. We plan to replace 5 small trailers with one double-wide 14'x52' 4-bedroom trailer. BLM plans to purchase two similar new doublewide trailers to match ours. This will eliminate a lot of clutter and an eyesore at the fire station.

Malheur Refuge hired 10 temporary fire employees. Our 1993 fire crew consisted of one GS-6 Engine Foreman (Mike Callaway) who quit on June 18 to take a permanent fire job with Oregon Department of Forestry. Andy Renc from Salem BLM took his place on June 27. Two other engine foremen were GS-5's (Doug Blair and Jeff Casey). One GS-4 firefighter (John Gasiorowski) worked from June 14 until July 31. He quit and bought a bicycle shop in Burns. The other five firefighters were GS-3's (Jason Langman, Jeff Stensen, Mike Patterson, Brenda Reynolds, and Aimee Smith). Debbie Hickey is our Dispatcher/Clerk. Doug Blair, Jeff Casey, John Gasiorowski, Brenda Reynolds, Aimee Smith, Debbie Hickey and Carla Burnside, the refuge archeologist, took the basic firefighter school (S130/190) in Burns June 14-18. FMO Blacker taught the suppression methods session of the course. About 40 new firefighters attended from BLM, USFS, USFWS, and Harney County. Blair, Gasiorowski, Casey, Langman, Stensen, and Patterson qualified as class A fallers in a class near Frenchglen taught by Mike Petersen (Ochoco National Forest) on July 25, 1993.



Simulated wildfires (real smoke) greeted trainees at the practical exercise near Idlewild on Malheur National Forest, June 17, 1993. RAB



Flame lengths and fire intensity increased as the fire headed upslope. June 93 RAB



Cup trenches were constructed at the base of the fire on the slope. Jun 93 RAB



Finishing the fireline in preparation for mop-up. Jun 93 RAB



Warren Davis (at right) from Modoc Refuge participated the entire week. Jun 93 RAB

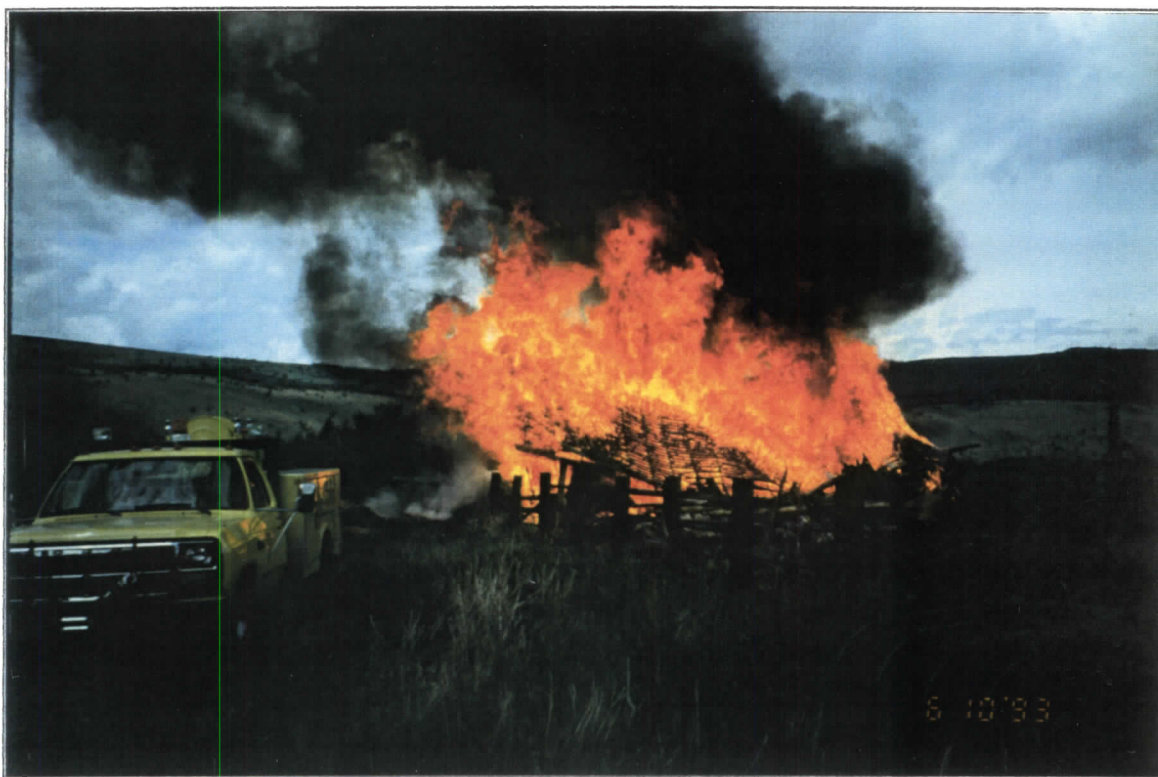


Debbie Hickey, our Dispatcher/Clerk completed the S-130/190 course. Jun 93 RAB

The fire crews accomplished the following tasks in 1993:

- ▶ Assisted in construction of the Buena Vista overlook interpretative site
- ▶ Dug and cleaned ditch for phone line to residences at headquarters (1500' long)
- ▶ Moved a new outhouse from headquarters to BV
- ▶ Mowed firebreaks around the Malheur Field Station
- ▶ Hauled barley seed from Klamath Refuge for wildlife food plantings
- ▶ Burned a fallen down milk barn at P-Ranch
- ▶ Disced and seeded wildlife food fields (250 ac.)
- ▶ Removed Russian Olive trees along the West Canal near Frenchglen
- ▶ Fenced Hogwallow Spring on boundary; put up boundary signs; and removed BLM cattle watering troughs from refuge land.
- ▶ Cleaned up old dump sites at the Diamond Corral (several truck loads)
- ▶ Removed interior fence near headquarters and along the Center Patrol Road
- ▶ Mowed firebreaks along more than 40 miles of refuge roads
- ▶ Cut, transported, and placed over 200 junipers to stabilize the banks of the Blitzen River
- ▶ Conducted 16 prescribed burns on Malheur; 2 on Finley Refuge
- ▶ Five firefighters received heavy equipment training at Klamath Refuge
- ▶ Demolished and poured new foundations for several refuge entrance signs
- ▶ Poured concrete sidewalks at volunteer house, footings for new shop hoist and heat pump
- ▶ Removed 2 miles of electric fence in the Krumbo fields
- ▶ Discovered and rotenoned carp near Wright's Pond
- ▶ Landscaped, planted grass, and watered around the Volunteer residence
- ▶ Disced a firebreak around Sodhouse Ranch; mowed weeds around buildings
- ▶ Cleaned up several truckloads of garbage and burned debris around the old Kado Barn site
- ▶ Repaired cut fence and broken boards at Mud Creek water gap

The crews built or rebuilt a total of 7 miles of fence this year.



The fallen down milk barn at P-Ranch went up in flames during a wet June day. RAB



Aimee Smith protecting a fence next to the burning barn. June 10, 1993 RAB



Repaired swinging board fence across Mud Creek on refuge boundary. The boards allow debris to move downstream but prevent cattle trespass. July 22, 1993 RAB

Five to ten small prescribed burns (20-1000 acres in size) are planned annually for the refuge in the Blitzen Valley and the Double-O management units. Between one and two thousand total acres are scheduled for prescribed burning each year. This is a reduction in the average acreage burned each year. The number of fires per year varies according to drought and weather conditions...less during drought years. Smaller site-specific burns can accomplish habitat objectives, while reducing smoke management concerns.

In October, Malheur fire crews assisted Western Oregon Refuges crews for a second year with the prescribe burning of 125 acres on Finley Refuge. The different fuel types, public, and environmental constraints encountered in western Oregon provided good experience for our eastern Oregon crews. A 2800 gallon heavy class A foam engine from the Salem BLM was used on the burns this year. After filling the 1300' hose lay along the south end of the N. Prairie burn and pre-wetting the fuels next to the fireline, the engine still had 800 gallons left. In the past this same task took several trips with Finley's 800 gallon LaFrance. The wet line was so effective,

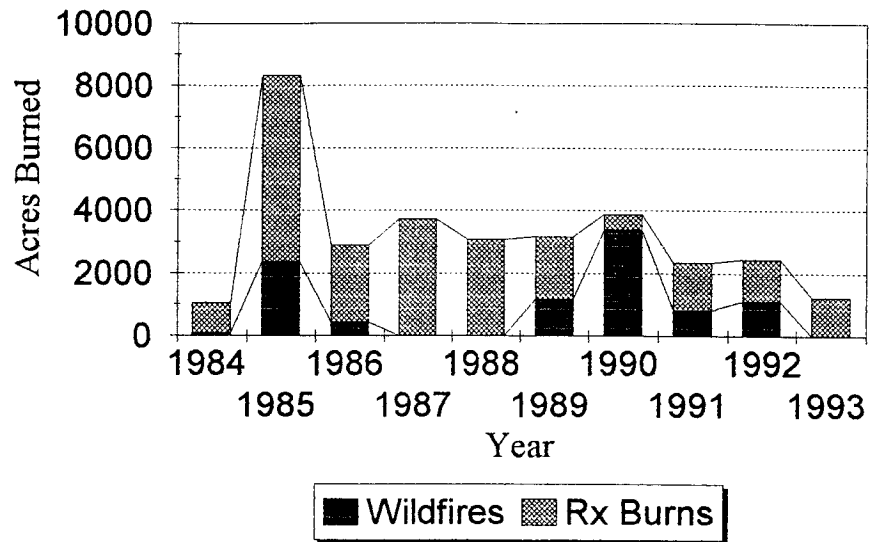
not much water was used during the burn. The foam capabilities of the cannons mounted on top of the engine were demonstrated after the burn by the BLM crew.



Deck cannons shot compressed air foam 200+ feet from BLM engine. Jun 93 RAB

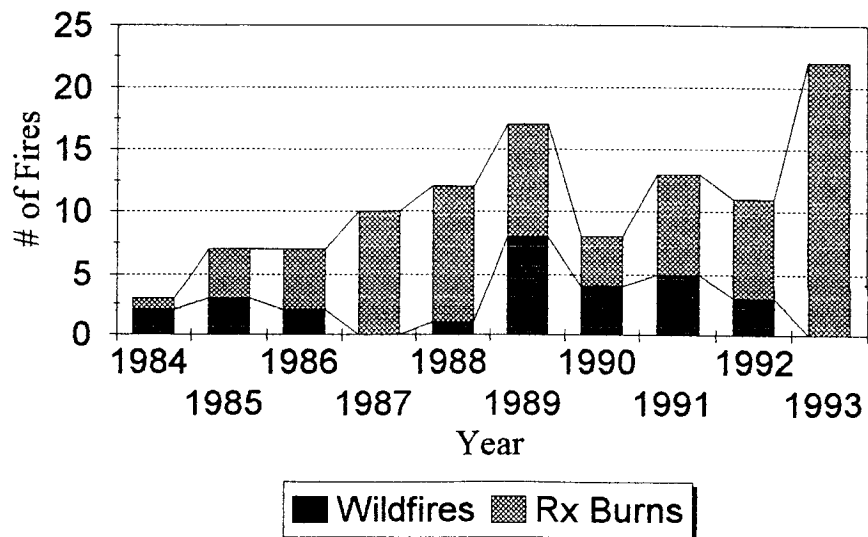
Malheur Refuge Fires

Acres Per Year



Malheur Refuge Fires

Number Per Year





Instructor Mike Petersen showing engine foreman Blair how to grease the clutch bearing on the Stihl 044 chain saw. July 25, 1993 RAB



Making sure the undercuts line up properly. July 25, 1993 RAB

10. Pest Control

In an effort to control the spreading infestation of noxious perennial pepperweed (*Lepidium latifolium*), 20 acres of the weed were mowed along refuge roads. Refuge Habitat Specialist, Joel David, and Refuge Fire Management Officer, Rod Blacker met with Dave Langland, Supervisory Agronomist for the Oregon Department of Agriculture and Scott Stenquist, Integrated Pest Management Coordinator for the Regional Office, to discuss additional controls of this weed. Several study plots are being considered to monitor the effects of fire, flooding and herbicide use on the plant, which has invaded refuge wetlands and riparian areas.

11. Water Rights

It was an active year for water rights. Approximately 1.5 years of effort went into the program during the year and approximately \$25,000 was spent on equipment and materials in direct support of the program.

Major accomplishments for the year include:

- Presented a half day workshop for the refuge staff on water rights and water law. The goal was to familiarize them with the topics so that they would be in a better position to protect refuge water rights through proper water use.
- Reviewed and made suggestions for improvement and correction of refuge water rights maps prepared by Regional Office engineering staff.
- Planned and designed a system for monitoring refuge water use to allow the refuge to report water usage within the accuracy limits imposed by the state.
- Installed recording stations on the East Canal, Blitzen River below Page Dam, West Canal, Bridge Creek and Blitzen River below Sodhouse Dam. Installations on Diamond Drain (Kiger Creek) and McCoy Creek are partially installed, but need additional work to make them operational. All stations except the East Canal still need to be calibrated.
- Measured or estimated water receipts from all major refuge water sources except the Silvies River for water year 1993 and began taking measurements for water year 1994.

- Prepared acquisition requests for water measuring and monitoring equipment. A Marsh-McBirney electronic flowmeter with accessories and Leupold-Stevens A/F loggers and associated equipment for recording stations were acquired.
- Reviewed plans and documents for refuge staff to assure compliance with water rights requirements.
- Provided information to staff members on water rights, water law and other water issues.
- Determined additional stream flows for staff members when requested.
- Prepared water rights budget and compiled assistance needs list for FY 94.
- Prepared water use reports for submittal to the Oregon Water Resources Department for water years 1992 and 1993. The 1993 reports were the first that could be certified to meet state accuracy requirements.
- Consulted with USGS regarding possible gaging of Malheur Lake water levels and several agencies regarding possible remote reporting stations for Krumbo and West Krumbo Creeks.
- Reviewed several applications from outside sources to determine if they might have adverse effects on refuge water resources.
- Did compliance checks on several non-refuge water rights to assure compliance.
- Made an in-depth review of all refuge water rights and recommended changes to bring the refuge into compliance.
- Assisted with Camas NWR water rights applications for the Snake River Basin adjudications.

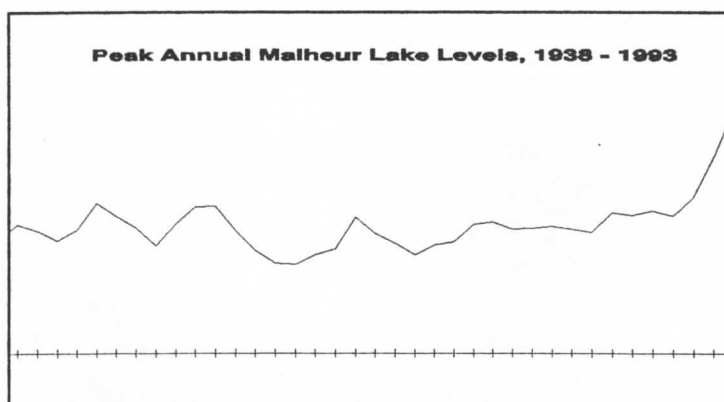
The prolonged drought of the past few years was finally broken during 1993. Precipitation was above average during the 1992-1993 winter, and although it was below average during most of the remainder of the year, copious snowpacks on watersheds serving the refuge resulted in near record runoffs during spring.

The March snow surveys for the Harney Basin indicated the Blitzen River watershed's snowpack was 198% of average; Silver Creek was 152% of average and the Silvies River was 153% of average. US Geological Survey (USGS) records for runoff from these watersheds are not yet available, but observations and measurements indicate well above average runoffs.

Water flows from the Blitzen River reaching Malheur Lake ranged from a low of 16 cubic feet per second (CFS) at the beginning of the year to a high of 788 CFS measured on March 23rd. About 40 CFS was still reaching the lake at the end of December. Total water reaching Malheur Lake from the Blitzen River was estimated to be 152,340 acre feet.

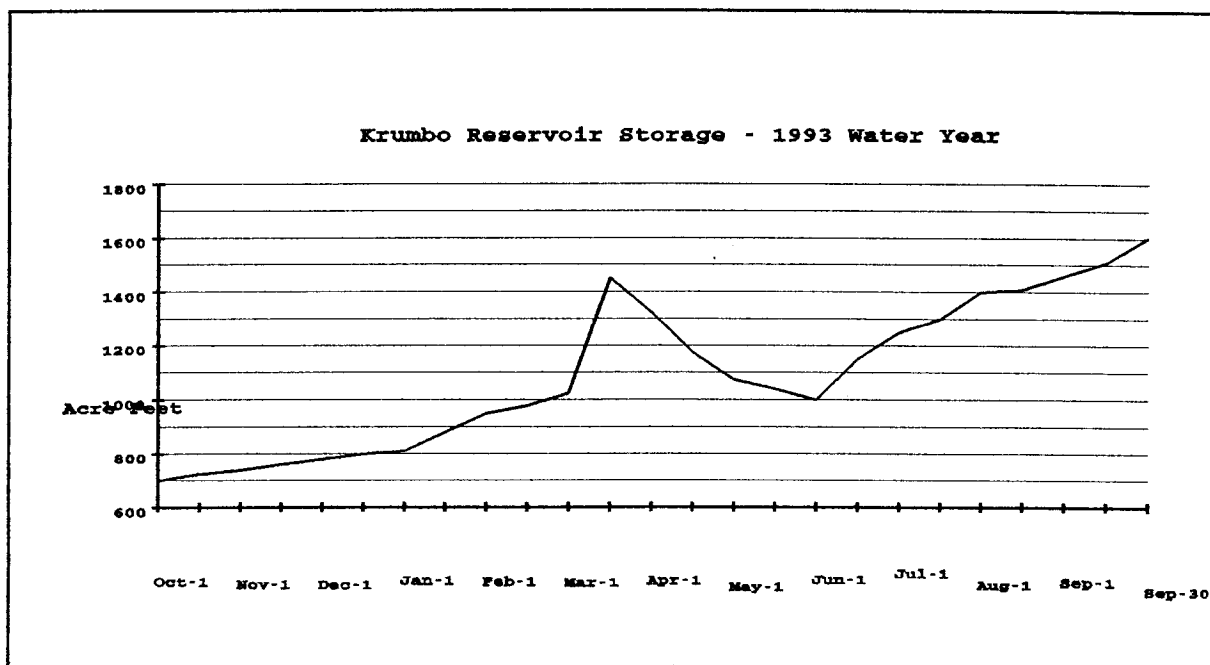
Unfortunately, the refuge does not have the capability of measuring water entering the refuge from the Silvies River. Reasonably large flows were received between April and early May. Unusually large flows were also received from Mallard Slough, northeast of Malheur Lake, which is usually a minor source of refuge water.

By the beginning of the year, Malheur Lake had a surface area of about 400 acres with 1 to 2 inches of water and was being maintained by minimal flows from the Blitzen River and Sodhouse Spring. By June 25th, the lake was at 55,000 acres with well over 300,000 acre feet of water. The elevation of the lake surface at this time was 4,094 feet, a level which has been exceeded only 15 times in the recorded history of the lake.



Water from Silver Creek, which supplies surface water for the Double-O Unit of the refuge, began entering the refuge March 24th when 950 CFS was flowing. The creek peaked at 1,311 CFS on March 29th and ceased flowing into the refuge about May 20th. A total of 60,258 acre feet was estimated to have reached the refuge from this source. Perhaps half this water flowed into Harney Lake.

The only disappointment so far was the quantity of runoff on the Krumbo Creek watershed. Observations in early spring indicated that the watershed received a light snowpack, the only area where this was observed. Hammond Ranch was also able to divert a sizeable quantity of water into Kern Reservoir prior to March 1st. Both factors prevented the



refuge from being able to fill Krumbo Reservoir to the maximum amount covered by the refuge's storage water rights. These rights allow storage of 1,660 acre feet. Maximum storage during the 1993 water year was 1,605 acre feet at the end of the year. Maximum storage during the spring was only 1,450 acre feet.

15. Private Lands

Three wetlands restoration projects were signed in 1993; all projects are on private lands. Dirt work began on two projects in the fall. The Projects are listed in Table XVI.

Table XVI Partners For Wildlife Projects, Malheur Refuge.

| Project Number | Owner | Total Cost | USFWS Percent | Project Description |
|------------------------|------------------|------------|---------------|--|
| 1993-01 | Dan Brown | \$13,020 | 49% | Development of 03 acre wetland\brood pond. Assist with elimination/reduction of Carp from spring system. |
| 1992-03 | Donna Webb Ranch | \$14,550 | 50% | Enhancement of riparian corridor through pond development and fence construction. |
| 1992-05 | Cliff Houck | \$13,740 | 50% | Development of a 2 acre brood pond. Fence construction of 1/4 mile. |
| TOTAL COST OF PROJECTS | | \$41,310 | | |

G. WILDLIFE1. Wildlife Diversity

A list of unusual birds documented on or near Malheur Refuge during 1993 appear in Table XVII.

Table XVII Unusual Bird Sightings and Dates at Malheur Refuge, 1993.

| SPECIES | NO. | DATE |
|-----------------------------|-----|---------------------------|
| Red-necked Grebe | 1 | 25 July, 4 Nov., 18 Dec. |
| Green-backed Heron | 1 | 24 Sept. |
| Mute Swan | 1 | 23 June - 28 July |
| Merlin | 1 | 5 March, 29 May, 10 Sept. |
| Peregrine Falcon | 2 | 31 Aug. - 27 Sept. |
| Whimbrel | 1 | 21 May |
| Baird's Sandpiper | 1 | 26 April, 4 Sept. |
| Sanderling | 4 | 31 April |
| Bonaparte's Gull | 2 | 1 May |
| Common Tern | 1 | 31 May |
| Band-tailed Pigeon | 1 | 3-6 April, 4-5 Oct. |
| Northern Saw-whet Owl | 1 | 1-2 Oct. |
| Black-chinned Hummingbird | 2 | 10-11 May |
| Calliope Hummingbird | 1 | 7-9 May |
| Dusky Flycatcher | 1 | 25 July |
| Least Flycatcher | 1 | 20&21 May, 3 June |
| Black Phoebe | 1 | 16 June |
| Scrub Jay | 1 | 30 May |
| Blue-gray Gnatcatcher | 2 | 29 May |
| Veery | 1 | 27 Feb., 2 June |
| Gray Catbird | 1 | 7 June |
| Northern Mockingbird | 2 | 1-4 June |
| Red-eyed Vireo | 1 | 4-5 June |
| Chestnut-sided Warbler | 1 | 26 June |
| Cape May Warbler | 1 | 3-4 Oct. |
| Black-throated Blue Warbler | 1 | 30 May |
| Black-throated Gray Warbler | 1 | 11 May, 2-10 June |
| Bay-breasted Warbler | 1 | 20 April |
| Blackpoll Warbler | 1 | 19-20 Sept. |
| Black-and-white Warbler | 1 | 29-30 May |
| American Redstart | 2 | 16 April, 1-11 June |
| Prothonotary Warbler | 1 | 30 May - 3 June |
| Hermit Warbler | 1 | 3 June |
| Blue-winged Warbler | 1 | 29 May |
| Palm Warbler | 1 | 19 Sept. |

Table XVII Continued

| SPECIES | NO. | DATE |
|------------------------|-----|------------------------|
| Ovenbird | 1 | 11-31 May, 3-4 June |
| Northern Waterthrush | 1 | 14 May, 5 June, 3 Oct. |
| Summer Tanager | 1 | 25 May |
| Rose-breasted Grosbeak | 1 | 5&10 June |
| Indigo Bunting | 1 | 12 June |
| Lincoln's Sparrow | 1 | 18 Dec. |
| White-throated Sparrow | 5 | 28 Sept. - 8 Oct. |
| Great-tailed Grackle | 3 | 4-28 June, 27 Sept. |
| Common Grackle | 2 | 1 June |
| Streak-backed Oriole | 1 | 1 Sept. - 1 Oct. |
| Red Crossbill | 5 | 29 July |

2. Endangered and Threatened Species

Peregrine falcons have been observed in the Harney Basin for the last six years and this year two sightings were reported on Malheur Refuge. The increasing number of peregrine sightings is probably related to an increase in breeding pairs in Oregon.

The refuge staff again participated in spring migration bald eagle roost counts. The counts are a multi-agency effort to document winter bald eagle numbers in Harney Basin. This year's data indicate a peak of 173 bald eagles, compared to 132 eagles last year, and the record peak of 263 eagles in 1991. Bald eagle roost counts were also conducted on the refuge from November 1992 through February 1993 at three locations; P-Ranch, Refuge Headquarters and Harney Lake. Total eagles observed during those months were: seven in November, twenty-five in December, nine in January, and seven in February. Refuge staff also participated in the mid-winter bald eagle count on January 11th and documented a total of 56 bald eagles using the basin.

3. Waterfowl

Midwinter Census

The midwinter waterfowl survey showed 11,103 Canada geese, 1,045 tundra swans, 32 trumpeter swans, and 3,674 ducks using the refuge. Duck numbers were similar to 1992, while goose numbers were 3,000 higher. Midwinter tundra swan numbers were at their highest since 1981. These high numbers were due to use of extensive stands of widgeon grass in Harney Lake, which supported the vast majority of waterfowl.

Spring Waterfowl Migration

Spring migration began in late February with the arrival of northern pintails, tundra swans, and snow geese. Peak numbers and dates for selected spring migrants appear in Table XVIII.

Table XVIII 1993 Estimated Spring Migration Waterfowl Peaks, Malheur Refuge.

| SPECIES | NUMBER | MONTH |
|-------------------|--------|-------|
| American Widgeon | 18,470 | March |
| Green-winged Teal | 7,637 | March |
| Mallard | 5,156 | May |
| Northern Pintail | 12,056 | March |
| Northern Shoveler | 8,554 | March |
| Ruddy Duck | 4,258 | March |
| Canvasback | 1,476 | March |
| Canada Goose | 1,479 | April |
| Snow Goose | 43,599 | March |
| Tundra Swan | 4,451 | March |

Table XIX summarizes spring waterfowl use-days for ducks, geese and swans. Spring waterfowl use remained high this year, however, total use-days were down from last year while trumpeter swan and goose use-days increased. Waterfowl use was again high on Harney Lake, which supported an abundant aquatic plant food supply.

Table XIX Spring Waterfowl Use-Days for Malheur Refuge, 1988-1993.

| SPECIES | Use-Days in Thousands | | | | | |
|----------------|-----------------------|---------|---------|---------|---------|---------|
| | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
| Tundra Swan | 12.5 | 57.2 | 19.6 | 30.2 | 207.8 | 140.1 |
| Trumpeter Swan | 4.9 | 1.2 | 1.8 | 1.1 | 2.3 | 3.4 |
| Geese | 265.8 | 1,786.1 | 274.0 | 564.6 | 1,410.9 | 1,570.3 |
| Ducks | 1,330.2 | 2,444.3 | 4,145.9 | 2,680.4 | 6,103.4 | 4,609.9 |
| TOTALS: | 1,613.4 | 4,288.8 | 4,441.3 | 3,276.3 | 7,724.8 | 6,323.6 |

Fall Waterfowl Migration

Fall waterfowl migration was impressive in 1993. Overall waterfowl use was extremely high (Table XX). Fall waterfowl peaks are listed in Table XX. Tundra swan use increased by a factor of 1.9, goose use by a factor of 1.6, and duck use by a factor of 2.2. Use by these species also showed dramatic increases in 1992. The increased duck and tundra swan use was due to the extensive aquatic plant beds in Harney and Malheur lakes, which supported over 90 percent of the duck use. Figure 5 illustrates the relationship between duck and swan use with acres of submergent plants on the refuge in recent years.

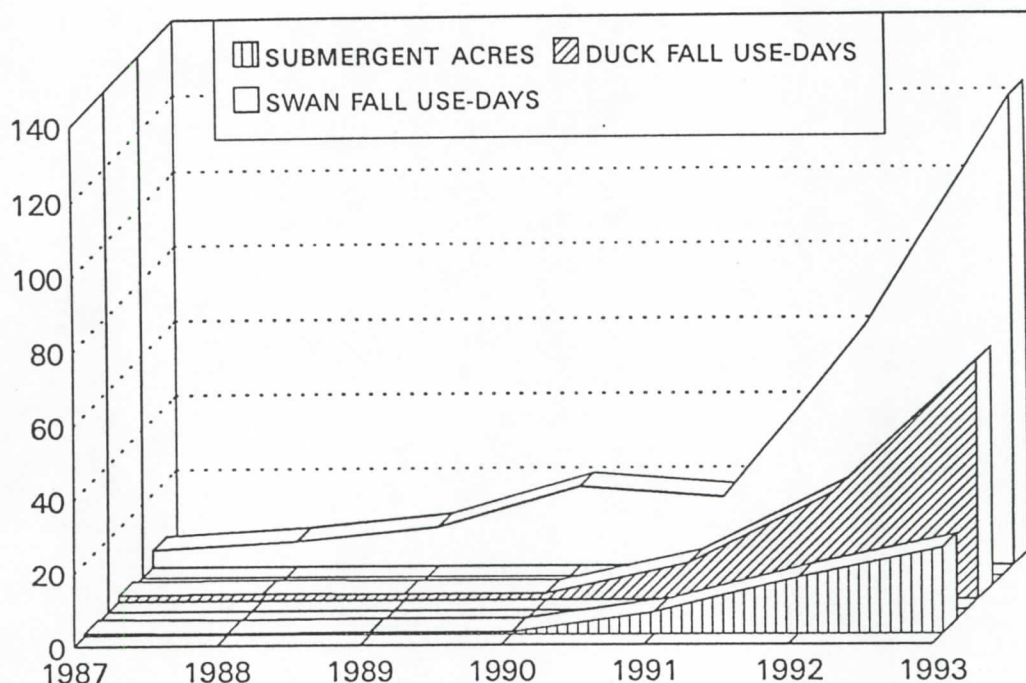
Table XX Fall Waterfowl Use-Days (Sept. 1 - Dec. 1) on Malheur Refuge, 1988-93.

| SPECIES | Use-Days in Thousands | | | | | |
|----------------|-----------------------|---------|---------|----------|----------|----------|
| | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
| Tundra Swan | 6.9 | 10.6 | 21.4 | 18.4 | 64.7 | 124.8 |
| Trumpeter Swan | 6.2 | 1.2 | 2.5 | 3.1 | 4.2 | 3.6 |
| Geese | 513.6 | 541.7 | 466.5 | 749.3 | 1,001.8 | 1,581.1 |
| Ducks | 1,859.8 | 1,687.8 | 1,694.8 | 10,032.8 | 28,888.1 | 64,098.6 |
| TOTAL: | 2,195.1 | 2,241.3 | 1,285.2 | 10,803.6 | 29,958.9 | 65,808.1 |

Table XXI Estimated Fall Waterfowl Peaks on Malheur Refuge, 1993.

| SPECIES | 1993 | | RECENT FALL PEAKS | |
|-------------------|---------|----------|-------------------|------|
| | NUMBER | PERIOD | NUMBER | YEAR |
| Mallard | 31,456 | October | 31,230 | 1980 |
| American Widgeon | 364,404 | October | 184,809 | 1992 |
| Northern Shoveler | 63,793 | October | 22,580 | 1979 |
| Green-winged Teal | 155,400 | October | 38,702 | 1992 |
| Canvasback | 24,625 | October | 20,950 | 1979 |
| Redhead | 67,423 | October | 44,008 | 1992 |
| Canada Goose | 21,866 | October | 16,323 | 1991 |
| Snow Goose | 767 | October | 8,000 | 1979 |
| Tundra Swan | 4,122 | November | 31,230 | 1980 |
| Northern Pintail | 20,608 | October | ----- | ---- |

Figure 5 Duck and Swan Fall Use-Days and Acres of Submergent Plants on Malheur Refuge, 1987 - 1993.



Duck use-days are in millions.

Swan use-days and submergent acres are in thousands.

Duck Breeding Population

The 1993 duck pair numbers totalled 21,174 and were up 74 percent from 1992. This was the highest pair count since 1957. Northern pintails, northern shovelers and diving duck pairs increased substantially, while mallard and green-winged teal pair numbers declined from 1992 levels. Estimated breeding pair numbers are summarized in Table XXII.

Malheur Lake supported the highest duck pair numbers, followed by the Double-O Unit (Unit 1), and the Sod House Unit (Unit 7). Harney Lake was the only unit in which duck pair numbers decreased in 1993. This was probably due to poor nesting cover around the lake and an abundance of good wetland breeding habitat in other units of the refuge. Malheur Lake was particularly productive for late nesting ducks, because carp were nearly eliminated during a fall 1992 rotenone

species, such as mallards, did not fare well on Malheur Lake when water levels rose four feet between March and June.

Table XXII Estimated Duck Pairs for Malheur Refuge, 1989-1993.

| SPECIES | YEAR | | | | | % CHANGE FROM 1992 |
|-------------------|-------|-------|-------|-------|-------|-----------------------|
| | 1989 | 1990 | 1991 | 1992 | 1993 | |
| Mallard | 1829 | 2203 | 2589 | 2767 | 2578 | - 7% |
| Gadwall | 1941 | 2969 | 1990 | 3340 | 4408 | + 32% |
| Northern Pintail | 608 | 210 | 387 | 334 | 3062 | + 817% |
| Green-winged Teal | 105 | 53 | 19 | 92 | 62 | - 33% |
| B.W./Cin. Teal | 3440 | 3006 | 3041 | 2222 | 3443 | + 50% |
| American Widgeon | 171 | 251 | 208 | 483 | 705 | + 46% |
| Northern Shoveler | 1035 | 480 | 1020 | 853 | 2025 | + 137% |
| Dabbler Subtotal | 9129 | 9172 | 9254 | 10091 | 16283 | + 61% |
| Redhead | 2422 | 1067 | 1361 | 1586 | 3431 | + 116% |
| Canvasback | 319 | 190 | 164 | 112 | 254 | + 126% |
| Lesser Scaup | 64 | 101 | 17 | 102 | 258 | + 153% |
| Ring-necked Duck | 5 | 5 | 251 | 10 | 25 | + 150% |
| Ruddy Duck | 407 | 405 | 7 | 279 | 894 | + 220% |
| Common Merganser | 8 | 0 | 36 | 10 | 29 | + 190% |
| Diver Subtotal | 3225 | 1768 | 1836 | 2099 | 4891 | + 133% |
| TOTAL DUCK PAIRS | 12354 | 10940 | 11090 | 12190 | 21174 | + 74% |

Duck Production

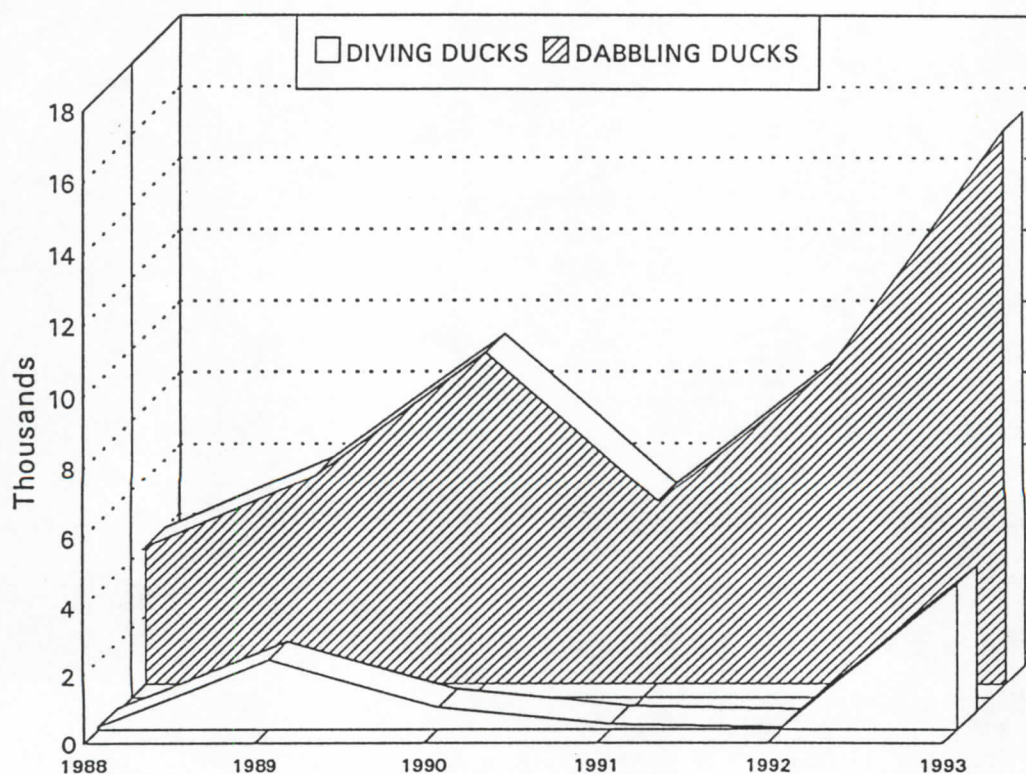
Duck nest data were collected for use in production estimates. Table XXIII summarizes duck nesting success via the Mayfield 40 percent method. Duck nest success was slightly higher than in 1992.

Table XXIII 1993 Duck Nest Success Rates from Nests
Monitored at Malheur National Wildlife Refuge,
Calculated Via the Mayfield 40 Percent Method.

| SPECIES | N | SUCCESS RATE |
|--------------------------|----|--------------|
| Mallard & Pintail | 46 | 26.5 % |
| Gadwall | 36 | 67.1 % |
| Cinnamon Teal & Shoveler | 20 | 35.7 % |
| Redhead & Canvasback | 8 | 30.8 % |

Since 1988, duck production estimates have included a factor for brood survival. Duck production estimates for 1993 totalled 19,973. Figure 6 shows duck production since 1988. Productivity, expressed as ducks produced per pair was 0.94 in 1993 compared to 0.75 in 1992, 0.49 in 1991, 0.92 in 1990, 0.65 in 1989 and 0.40 in 1988.

FIGURE 6 Duck Production at Malheur Refuge, 1988 - 1993



Canada Goose Production

An estimated 527 breeding pairs of Canada geese were recorded during the April goose pair count. This is eleven pairs less than the number recorded in 1992, and 39 percent lower than the previous ten-year average. Because of rapidly changing water levels (a four foot rise in less than four months) in Malheur Lake, Canada geese were displaced as they attempted to nest. Overall goose nest success averaged 49 percent. The Double-0 Unit had the highest nest success rate (65 percent), followed by the south Blitzen Valley (57 percent), and the north Blitzen Valley (52 percent). No successful nests were recorded from Malheur, Mud or Harney Lakes.

Goose production for 1993 was estimated to be 951, slightly higher than 1992, but 43 percent less than the 10 year average (1982-1992) of 1,669. Overall population estimates for 1993 decreased by 421 geese and 39 percent from the ten-year average. This decrease was apparently due to early spring abandonment of the refuge by both breeding and non-breeding geese because of extreme flooding conditions in Malheur and Mud Lakes, which significantly reduced the amount of suitable breeding habitat.

Trumpeter Swan Production

Eighteen trumpeter swans were produced on Malheur Refuge in 1993, 78 percent higher than the previous ten-year average. Average brood size was 3.0, slightly above average. Seven pairs nested this year, but only six were successful in raising broods. Nests were located at Darnell, Cottonwood, Jones, Benson, East Buena Vista, Knox Swamp and Unit 8 Ponds. The spring count showed 26 trumpeter swans in the area. Two nonbreeders and nine unfledged cygnets were captured and moved in late July to Summer Lake Wildlife Area (see Section J1). The fall trumpeter count (early October) showed 36 trumpeters, including nine cygnets. Table XXIV summarizes historic swan production data for the population.



Table XXIV Summary of Trumpeter Swan Production in Eastern Oregon, 1958-1992.

| YEAR | YOUNG PRODUCED | MEAN BROOD SIZE AT FLEDGE (ACTUAL SIZES) | NUMBER OF SUCCESSFUL BROODS |
|------|----------------|---|--------------------------------|
| 1958 | 4 | 2.0 | 2 |
| 1959 | 0 | 0.0 | 0 |
| 1960 | 14 | 2.8 (5,3,3,2,1) | 5 |
| 1961 | 0 | 0.0 | 0 |
| 1962 | 3 | 1.5 (2,1) | 2 |
| 1963 | 17 | 3.4 | 5 |
| 1964 | 6 | 2.0 | 3 |
| 1965 | 11 | 2.8 (5,3,2,1) | 4 |
| 1966 | 12 | 3.0 (5,3,3,1) | 4 |
| 1967 | 12 | 4.0 (6,4,2) | 3 |
| 1968 | 11 | 2.2 (4,2,2,2,1) | 5 |
| 1969 | 14 | 3.5 (5,4,4,1) | 4 |
| 1970 | 13 | 3.3 (4,4,3,2) | 4 |
| 1971 | 22 | 3.6 (5,4,4,4,3,2) | 6 |
| 1972 | 13 | 2.6 (3,3,3,2,2) | 5 |
| 1973 | 4 | 4.0 (4) | 1 |
| 1974 | 9 | 3.0 (5,2,2) | 3 |
| 1975 | 7 | 2.3 (4,2,1) | 3 |
| 1976 | 8 | 4.0 (4,4) | 2 |
| 1977 | 0 | 0.0 | 0 |
| 1978 | 13 | 2.6 (4,3,2,2,2) | 5 |
| 1979 | 33 | 3.3 (6,5,5,4,3,3,3,2,1,1) | 10 |
| 1980 | 15 | 2.1 (4,4,2,2,1,1,1) | 7 |
| 1981 | 9 | 3.0 (3,3,3) | 3 |
| 1982 | 17 | 2.8 (6,3,3,3,1,1) | 6 |
| 1983 | 17 | 2.8 (5,4,3,2,1,1) | 6 |
| 1984 | 6 | 3.0 (3,3) | 2 |
| 1985 | 2 | 1.0 (1,1) | 2 |
| 1986 | 24 | 3.4 (6,6,3,3,3,2,1) | 7 |
| 1987 | 14 | 2.3 (4,4,3,1,1,1) | 6 |
| 1988 | 8 | 2.0 (3,2,2,1) | 4 |
| 1989 | 3 | 1.5 (2,1) | 2 |
| 1990 | 7 | 3.5 (5,2) | 2 |
| 1991 | 14 | 2.3 (5,3,2,2,1,1) | 6 |
| 1992 | 6 | 3.0 (2,4) | 2 |
| 1993 | 18 | 3.0 (6,3,3,3,2,1) | 6 |
| | 386 | 2.8 average | 137 |

4. Marsh and Waterbirds

Coot Production

Coots are counted during the annual duck pair counts. Coot pairs increased 455 percent over 1992 numbers to an estimate of 6,055 breeding pairs. Estimated coot production was 12,053. This was 578 percent higher than in 1992, and was the highest estimate since 1989.

Colonial Nesting Waterbirds

Nesting colonial waterbirds were censused on the refuge, and elsewhere in Harney County (Table XXV). This year's colonial waterbird surveys included a helicopter survey on June 28th (courtesy of ODFW), several fixed-wing aircraft flights, and ground visits to some colonies during the breeding season.

Colonial waterbird production in 1993 (a wet year) was greatly improved over 1992 (a drought year). Twenty-four active colonies were located and censused in Harney County. Figures 7, 8 and 9 show pairs of cormorants, herons, egrets, and white-faced ibises counted in the basin.

FIGURE 7 Estimates of Nesting Pairs of Colonial Waterbirds using Malheur-Harney Lakes Basin, 1966-1993.

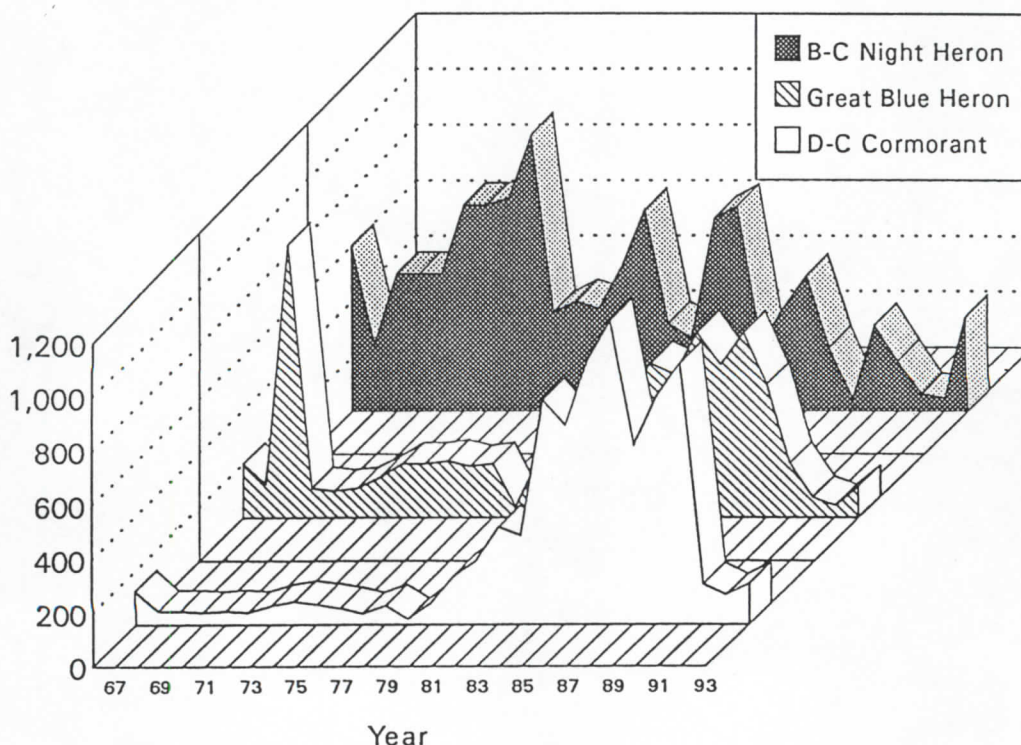


FIGURE 8 Estimates of Nesting Pairs of Egrets using the Malheur-Harney Lakes Basin, 1966-1993.

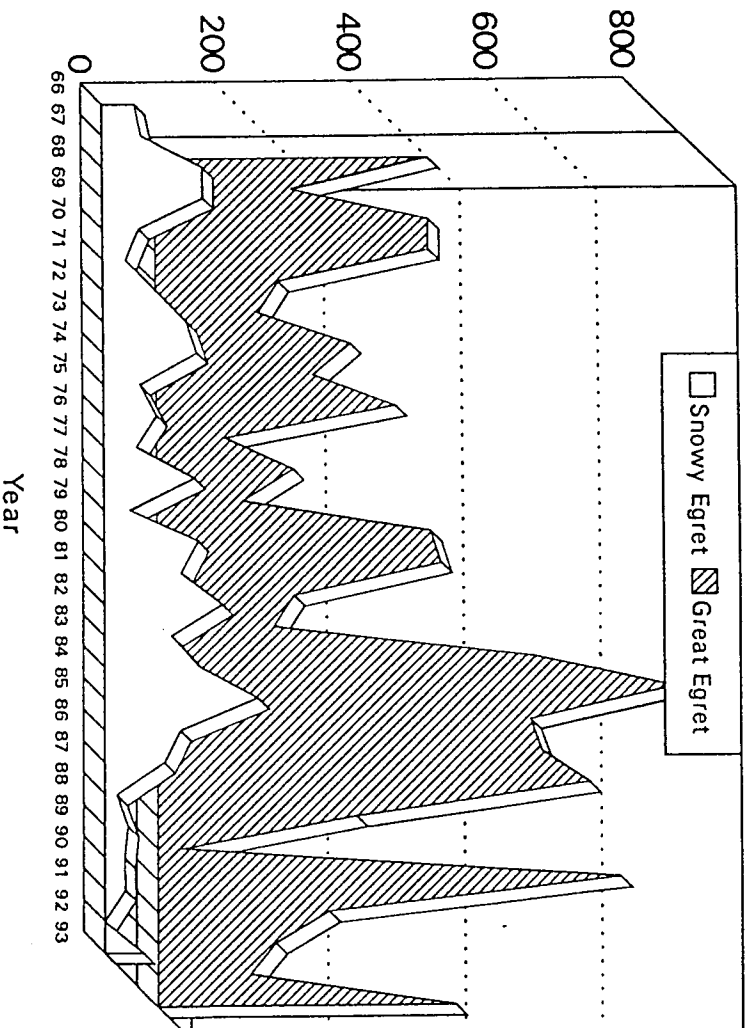


FIGURE 9 Estimates of Nesting Pairs of White-faced Ibis using the Malheur-Harney Lakes Basin, 1980-1993.

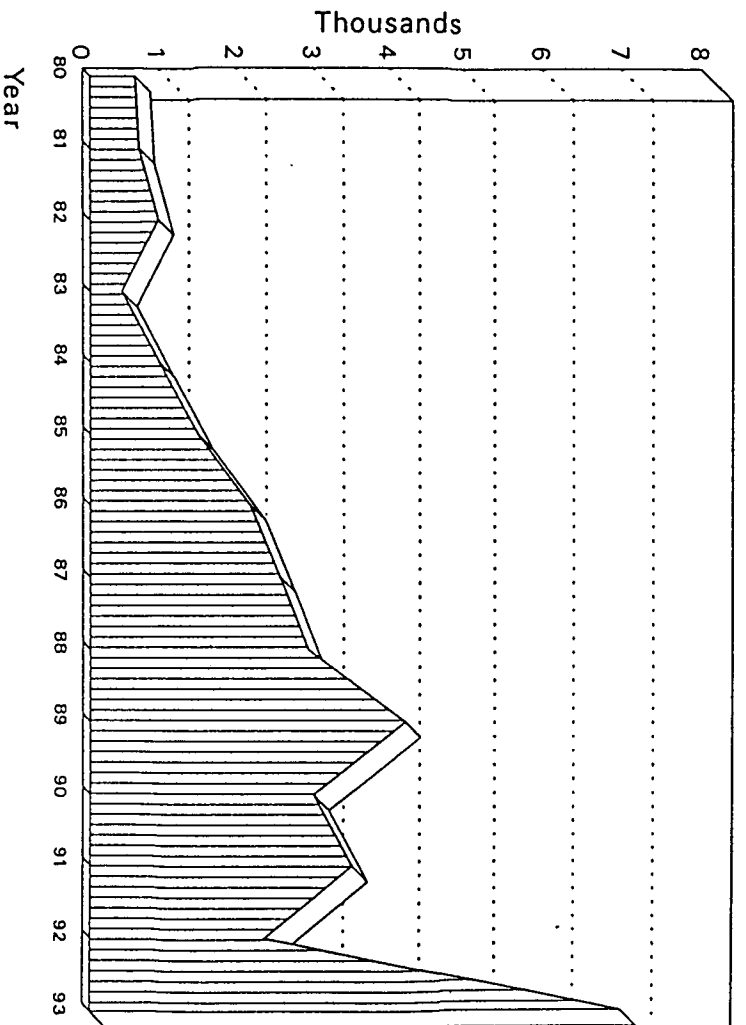


Table XXV Colonial-Nesting Waterbird Production Summary,
Malheur Refuge and Harney Basin, 1993.

| SPECIES | # PRODUCED ON-REFUGE | # PRODUCED OFF-REFUGE | TOTAL |
|---------------------------|-------------------------|--------------------------|--------|
| Eared Grebe | 523 | 0 | 523 |
| Western/Clark's Grebes | 885 | 0 | 885 |
| American Pelican | 0 | 0 | 0 |
| Double-crested Cormorant | 132 | 60 | 192 |
| Great Blue Heron | 20 | 154 | 174 |
| Black-crowned Night-Heron | 451 | 308 | 759 |
| Great Egret | 369 | 607 | 976 |
| Snowy Egret | 32 | 72 | 104 |
| White-faced Ibis | 17,790 | 0 | 17,790 |

GREATER SANDHILL CRANES

Sandhill crane pairs are tallied while they are on their territories during the spring. A total of 230 crane pairs were counted in 1993. This represents an increase of 41 pairs from the 1992 count. This is the highest pair count since 1972. Table XXVI summarizes numbers of active crane territories by biological unit.

Table XXVI Number of Sandhill Crane Pairs Found on
Territories in 1993 at Malheur National Wildlife
Refuge, by Biological Unit.

| | Biological Unit | | | | | | | | | TOTAL |
|---------------------------|-----------------|---|-------|----|----|----|----|----|----|-------|
| | 1 | 3 | 4-5-6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Number of Crane Pairs: | 37 | 1 | 3 | 28 | 28 | 22 | 14 | 37 | 60 | 230 |

Seventy-five territories not tallied in 1992 were identified this year. Many of these represent old territories which were inactive in 1992 because of poor water conditions, while others represent new pairs establishing territories. Thirty-four territories which were active in 1992 were inactive this year. These losses and gains can be attributed to shifting of territory sites, pair mortality, and recruitment of new pairs.

Sixty-three crane nests were located in 1993. Table XXVII summarizes nest fate data for crane nests monitored on the refuge since 1966. Overall nesting success was 83 percent in

1993, a tie with the 1990 record. Of the nests monitored predators destroyed eight percent, three percent had infertile eggs, and two nests were lost to flooding.

Crane colts in the Double-O and Blitzen Valley were counted from the air on August 23rd using ADC's Husky aircraft. These aerial data were supplemented with ground counts. These counts indicate that at least 40 colts were produced on the refuge in 1993. Nine colts were recorded in the Double-O, two in Mud Lake, and the remaining 29 in the Blitzen Valley.

Assuming 230 refuge crane pairs nested, and with 83 percent nesting success, an estimated 191 nests hatched. Using an average clutch size of 1.92, an estimated 367 colts hatched. With 40 crane colts fledging, estimated brood survival was 10.9 percent. Conversely, mortality was 89.1 percent. This brood survival rate is below the predator control plan goal of 25 percent.

Refuge biologists again conducted a telemetry study of crane colt mortality. Data from this year of the study showed mortality at 81.5 percent. Predation was the most important factor in colt losses during the study, with predators taking 42 percent of the study birds. Important predators identified in the study this year included coyotes, mink, great-horned owls and golden eagles.

Crane recruitment for Malheur Refuge has been calculated via the following formula:

$$\frac{\text{Number of colts which fledged}}{\text{Number of nesting pairs} \times 2 + \text{young}} = \text{Recruitment rate.}$$

Therefore, recruitment for 1993 is calculated as follows:

$$\frac{40}{(230 \times 2) + 40} = \frac{40}{500} = 8.0 \text{ percent}$$

Table XXVII Nest Fates of Greater Sandhill Crane Nests Monitored on Malheur National Wildlife Refuge, Oregon; 1966-1993 (Percentages in Parentheses).

| Year | NEST STATUS | | | | | | | | | |
|------------|-------------|----------|-----------|---------|-----------|----------|---------|---------|--------|---------|
| | Sample Size | Hatched | Abandoned | Flooded | Infertile | Predated | Raven | Raccoon | Coyote | Unknown |
| 1966 | 51 | 18 (35) | 7 (14) | 0 | 0 | 26 (51) | 9 | 6 | 4 | 7 |
| 1967 | 59 | 25 (42) | 1 (2) | 0 | 0 | 33 (56) | 13 | 14 | -- | 6 |
| 1969 | 88 | 52 (59) | 3 (3) | 1 (1) | 0 | 32 (36) | 10 | 12 | 1 | 9 |
| 1970 | 86 | 44 (45) | 4 (5) | 0 | 0 | 38 (50) | 17 | 9 | 1 | 11 |
| 1971 | 83 | 44 (53) | 0 | 0 | 0 | 39 (47) | 16 | 10 | 1 | 12 |
| 1973 | 49 | 10 (20) | 1 (2) | 0 | 1 (2) | 37 (76) | 20 | 4 | 5 | 8 |
| 1974 | 50 | 18 (36) | 2 (4) | 0 | 0 | 30 (60) | 14 | 2 | 7 | 7 |
| 1976 | 52 | 35 (67) | 0 | 0 | 1 (2) | 16 (31) | 4 | 6 | 0 | 6 |
| 1977 | 50 | 23 (46) | 0 | 0 | 1 (2) | 26 (52) | 9 | 6 | 3 | 8 |
| 1978 | 55 | 19 (34) | 1 (2) | 10 (18) | 1 (2) | 24 (44) | 7 | 5 | 5 | 7 |
| 1980 | 30 | 16 (53) | 1 (3) | 2 (7) | 0 | 11 (37) | 4 | 2 | 1 | 4 |
| 1981 | 31 | 15 (48) | 0 | 0 | 2 (7) | 14 (45) | 5 | 2 | 0 | 7 |
| 1982 | 81 | 54 (67) | 2 (2) | 0 | 1 (1) | 24 (30) | 8 | 2 | 3 | 11 |
| 1983 | 60 | 38 (63) | 3 (5) | 3 (5) | 1 (2) | 15 (25) | 2 | 5 | 5 | 4 |
| 1984 | 67 | 23 (34) | 2 (3) | 5 (7) | 3 (5) | 34 (51) | 8 | 5 | 8 | 13 |
| 1985 | 50 | 24 (48) | 1 (2) | 0 | 0 | 25 (50) | 7 | 1 | 0 | 17 |
| 1986 | 60 | 40 (67) | 2 (3) | 0 | 2 (3) | 16 (27) | 2 | 2 | 1 | 11 |
| 1987 | 61 | 35 (57) | 2 (3) | 0 | 3 (5) | 21 (34) | 4 | 4 | 0 | 13 |
| 1988 | 67 | 51 (76) | 3 (5) | 0 | 1 (1) | 12 (18) | 4 | 1 | 0 | 7 |
| 1989 | 70 | 43 (61) | 2 (3) | 0 | 2 (3) | 23 (33) | 9 | 4 | 3 | 7 |
| 1990 | 60 | 50 (83) | 4 (7) | 0 | 1 (2) | 5 (8) | 2 | 2 | 0 | 1 |
| 1991 | 77 | 39 (50) | 0 | 9 (12) | 10 (13) | 19 (25) | 1 | 0 | 4 | 14 |
| 1992 | 57 | 38 (67) | 3 (5) | 0 | 5 (9) | 11 (19) | 3 | 1 | 4 | 3 |
| 1993 | 63 | 52 (83) | 1 (2) | 2 (3) | 3 (5) | 5 (8) | 0 | 1 | 0 | 4 |
| TOTAL:1457 | | 806 (55) | 44 (3) | 32 (2) | 38 (3) | 536 (37) | 178(12) | 106(7) | 55(4) | 197(14) |

Table XXVIII summarizes colt mortality rates and recruitment estimates for the refuge crane population since 1970. Estimated mortality was high this year. Table XXVIII also expresses recruitment as colts fledged per 100 pairs. This provides a more comparable number between years. The number of colts fledged per 100 pairs for the five year period before the predator control program averaged 9.8, compared to 15.9 for the eight years of predator control. The 1988 and 1990, and 1992, colt counts were incomplete because of apparent early migration as a result of poor local food supplies caused by drought conditions.

Higher productivity this year is believed to be due to excellent water conditions. A factor which may have lowered productivity is the inexperience of new young crane pairs. At

least 40 pairs nested for their first time this year. According to C.D. Littlefield (personal communication), young cranes are generally unproductive for the first few years of attempted breeding and must learn to become good parents to successfully raise young.

Table XXVIII Estimated Mortality and Recruitment Rates for Greater Sandhill Cranes Nesting on Malheur Refuge; 1970-1993.

| Year | Percent Mortality | No. Young Fledged | Percent Recruitment | Colts fledged/ 100 pairs |
|--|-------------------|-------------------|---------------------|--------------------------|
| 1970 | 66.5 | 68 | 12.5 | 28.9 |
| 1971 | 80.7 | 46 | 8.9 | 19.6 |
| 1972 | ** | 43 | 8.3 | 18.3 |
| 1973 | 98.0 | 2 | 0.4 | 0.8 |
| 1974 | 98.8 | 2 | 0.4 | 0.8 |
| 1975 | ** | 17 | 3.5 | 7.2 |
| 1976 | 84.6 | 47 | 9.1 | 19.9 |
| 1977 | 85.5 | 27 | 5.8 | 11.4 |
| 1978 | 70.1 | 43 | 8.9 | 19.6 |
| 1979 | ** | 39 | 8.1 | 17.8 |
| 1980 | 84.9 | 34 | 7.1 | 15.5 |
| 1981 | 88.7 | 23 | 5.0 | 10.5 |
| 1982 | 90.1 | 25 | 5.5 | 11.7 |
| 1983 | 84.8 | 39 | 8.4 | 18.2 |
| 1984 | 93.9 | 8 | 1.8 | 3.7 |
| 1985 | 92.6 | 9 | 2.4 | 4.8 |
| 1986 | 77.6 | 50 | 12.1 | 27.6 |
| 1987 | 78.4 | 43 | 10.6 | 23.7 |
| *1988 | ** | 6 | 2.1 | 3.1 |
| 1989 | 75.0 | 49 | 12.7 | 29.1 |
| *1990 | 87.7 | 22 | 5.8 | 12.4 |
| 1991 | 92.6 | 15 | 3.4 | 7.0 |
| *1992 | 94.2 | 16 | 4.0 | 7.0 |
| 1993 | 89.1 | 40 | 8.0 | 17.4 |
| * Dry years, cranes migrated early, therefore counts should be considered low. | | | | |

Crane production was good this year as a result of excellent water conditions. Crane pair numbers increased significantly from 1992 and should continue to rise for the next couple of years as new pairs begin nesting. Nest success was at record levels, although brood survival was only 10.9 percent. Based on the telemetry study, brood losses are still primarily the result of predation by a wide variety of predators.

Sandhill crane fall use for 1993 was below the twenty year average of 77,226 crane fall use-days, but was above the average of 50,277 for the past ten years and the third highest since 1984 (Table XXIX). An extremely wet spring resulted in a planting delay for three grainfields, which produced only average yields of barley. Peak use occurred in early August, when the local population remained on the refuge, and in mid-October when the largest numbers of migrants were present.

Table XXIX Greater Sandhill Crane Fall Use-Days on Malheur Refuge, Oregon, 1973-1993.

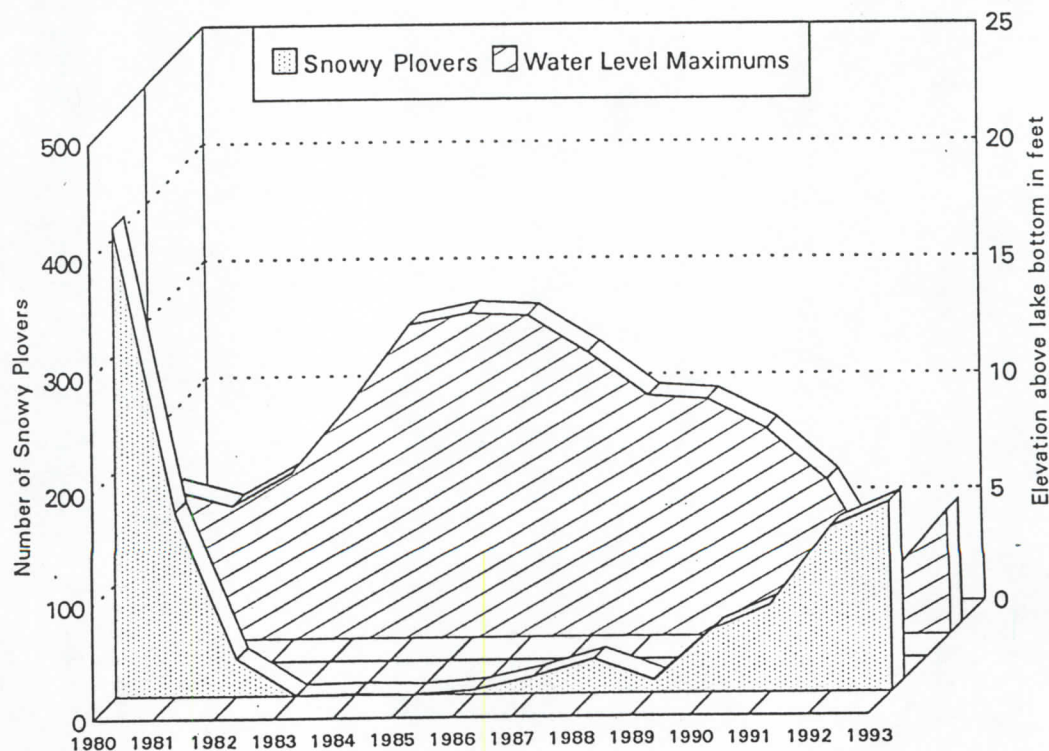
| YEAR | CRANE FALL USE-DAYS |
|------|---------------------|
| 1973 | 44,916 |
| 1974 | 31,043 |
| 1975 | 118,569 |
| 1976 | 70,401 |
| 1977 | 176,769 |
| 1978 | 104,302 |
| 1979 | 161,537 |
| 1980 | 101,209 |
| 1981 | 89,445 |
| 1982 | 143,566 |
| 1983 | 64,884 |
| 1984 | 95,309 |
| 1985 | 53,354 |
| 1986 | 34,075 |
| 1987 | 40,834 |
| 1988 | 12,163 |
| 1989 | 43,819 |
| 1990 | 20,840 |
| 1991 | 123,535 |
| 1992 | 13,955 |
| 1993 | 60,600 |

5. Shorebirds, Gulls, Terns, and Allied Species

Refuge biologists again participated in the Pacific Flyway Project. This project entails spring and fall shorebird surveys of all major coastal and inland shorebird staging areas. The survey is coordinated by biologists from Point Reyes Bird Observatory. During the late April spring count, Malheur, Mud, Harney, and Stinking Lakes were censused, and a total of 4,101 shorebirds were counted. The late August fall shorebird count was conducted on Malheur, Mud and Stinking Lakes, where a total of 4,600 shorebirds were counted. Due to high water levels in the lakes, these numbers are about half the 1992 count, when mudflats were more prominent.

Snowy plovers were counted in mid June, and 176 plovers were tallied on the refuge. This is the highest number since 1980, when a total of 411 snowy plovers were counted (Figure 10).

FIGURE 10 Numbers of Snowy Plovers Counted Compared to Water Levels in Malheur Lake, 1980-1993.





One of many avocet using the refuge for nesting. JS 5/93

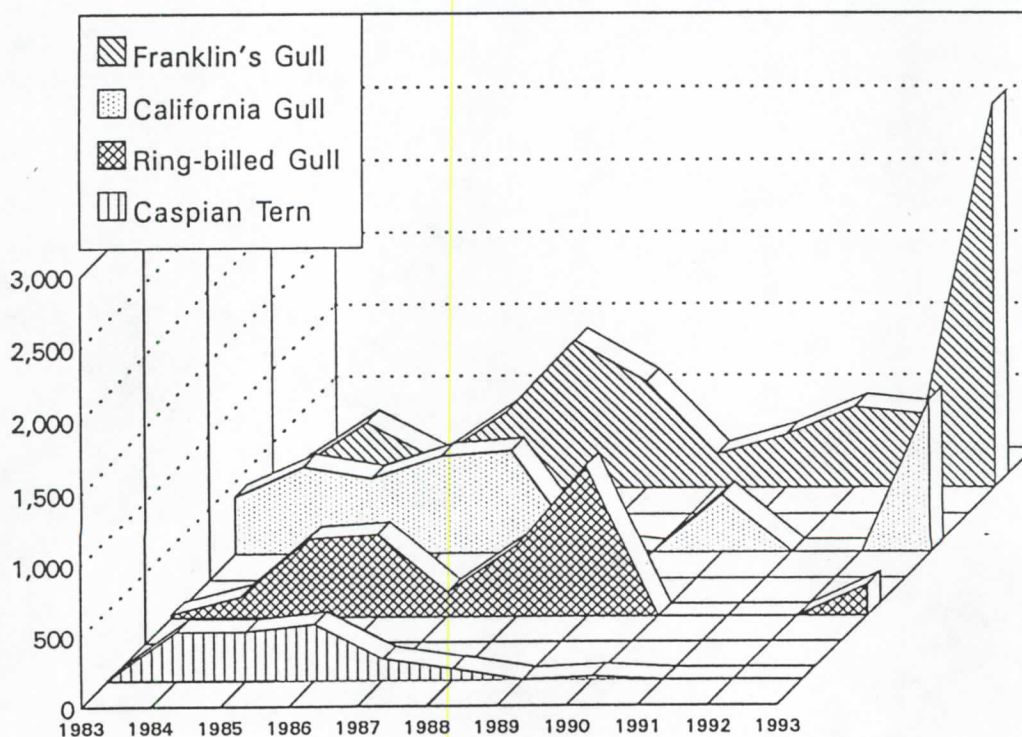
A large gull colony was present at the Hines City Sewer Ponds and contained a mix of California and ring-billed gulls. An estimated 1,000 California gull nests and 200 ring-bill nests were present at this site. A smaller gull colony containing 45 California and 20 ring-billed gull nests was active on small islands in the Dredger #2 Field on the refuge. Two large Franklin gull colonies, containing an estimated 2,000 and 600 nests, respectively, were active in the Lava Swamp Field and Diamond Swamp. Two smaller colonies contained 25 and 20 nests respectively at Ibis Pond and in Malheur Lake. This brings the 1993 total pairs of Franklin Gulls to a record high of 2,645, nearly double the previous record. Forester's terns nested in three colony sites containing a total of 320 nests. Figure 11 shows pair estimates of gulls and Caspian terns since 1983, while Table XXX shows production estimates.

Table XXX Colonial-Nesting Waterbird Production Summary,
Malheur Refuge and Harney Basin, 1993.

| SPECIES | # PRODUCED ON-REFUGE | # PRODUCED OFF-REFUGE | TOTAL |
|------------------|-------------------------|--------------------------|-------|
| Franklin's Gull | 2,751 | 0 | 2,751 |
| California Gull | 40 | 300 | 340 |
| Ring-billed Gull | 10 | 50 | 60 |
| Caspian Tern | 0 | 0 | 0 |

Forster's terns nested in three colony sites, with the largest colony in Malheur Lake containing 300 nests and two small colonies at Diamond Swamp and East Buena Vista Pond containing an estimated 10 nests each.

FIGURE 11 Estimates of Nesting Pairs of Gulls and Terns using
the Malheur-Harney Lakes Basin, 1983-1993.



6. Raptors

Quarterly Raptor Counts

The refuge continues to conduct raptor surveys with ODFW. Other cooperators include the Forest Service, the BLM and Eastern Oregon Agricultural Research Station - Burns Station. These surveys were initiated by the refuge and Ecological Services in 1975 to document seasonal raptor use in Harney Basin. Data are collected from 15 different survey routes in the Basin. Table XXXI summarizes raptor counts from 1991 to 1993. Figures 12 and 13 display some of the long-term data collected during the surveys.

FIGURE 12 **Golden Eagles and American Kestrels in the Harney Basin, 1979 - 1993.**

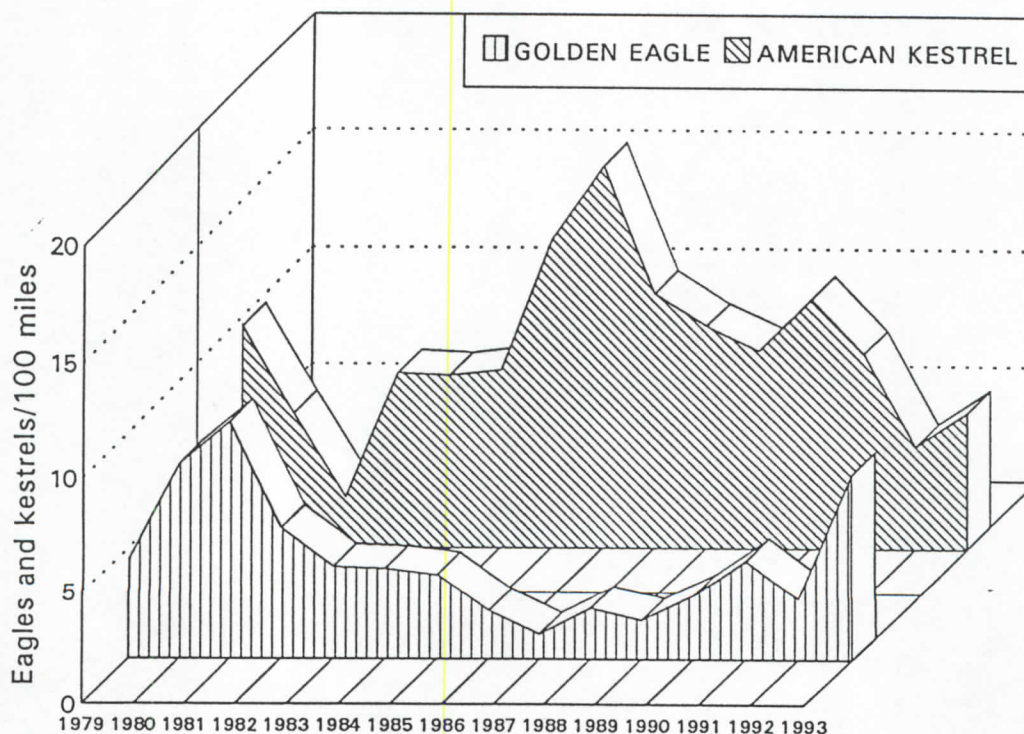


FIGURE 13

Red-tailed Hawks, Turkey Vultures, and Northern Harriers using the Harney Basin, 1979-1993.

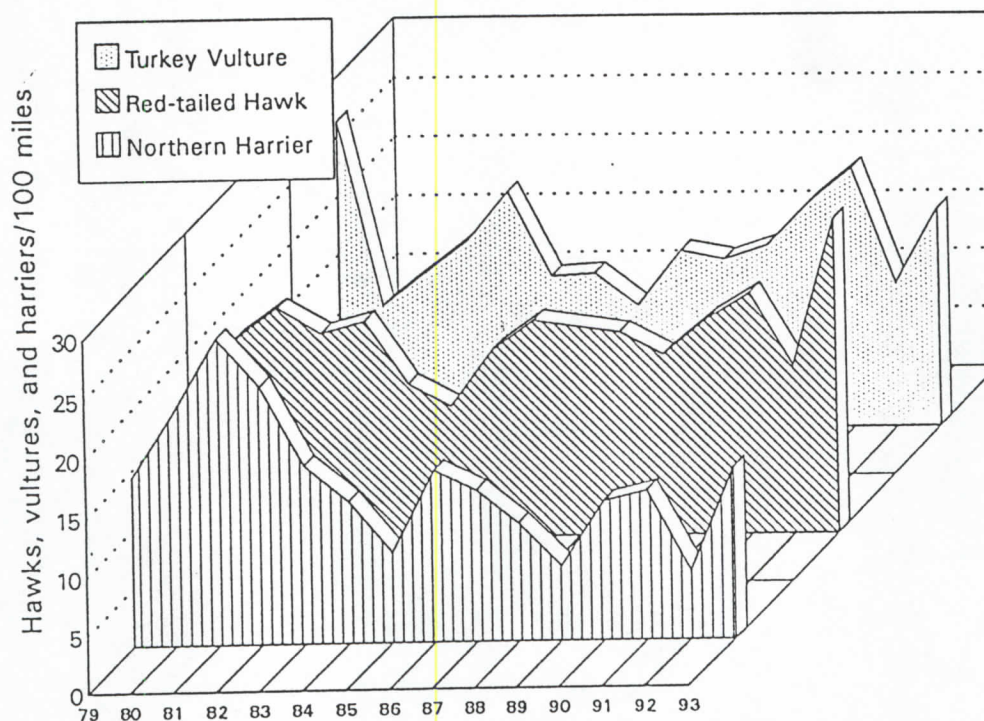


Table XXXI Annual Summary of Raptors Observed on Quarterly Counts in 1991-1993.

| RAPTOR SPECIES | WINTER | | | SPRING | | | SUMMER | | | FALL | | |
|------------------|--------|------|----|--------|------|----|--------|------|----|------|------|-----|
| | 91-- | 92-- | 93 | 91-- | 92-- | 93 | 91-- | 92-- | 93 | 91-- | 92-- | 93 |
| Prairie Falcon | 5 | 6 | 1 | 5 | 8 | 4 | 3 | 5 | 2 | 6 | 4 | 4 |
| Peregrine Falcon | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Merlin | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| American Kestrel | 5 | 4 | 1 | 42 | 6 | 18 | 20 | 13 | 10 | 29 | 26 | 29 |
| Ferruginous Hawk | 2 | 2 | 5 | 12 | 5 | 7 | 7 | 6 | 6 | 20 | 9 | 7 |
| Red-tailed Hawk | 14 | 8 | 13 | 40 | 45 | 56 | 75 | 49 | 51 | 100 | 53 | 140 |
| Rough-leg Hawk | 62 | 41 | 76 | 3 | 0 | 0 | 0 | 0 | 0 | 10 | 7 | 1 |
| Swainson's Hawk | 0 | 0 | 6 | 15 | 5 | 3 | 8 | 12 | 15 | 30 | 8 | 40 |
| Unident. Buteo | 1 | 7 | 3 | 3 | 6 | 8 | 5 | 5 | 4 | 1 | 7 | 17 |
| Cooper's Hawk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Sharp-shin Hawk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| North. Harrier | 25 | 8 | 21 | 87 | 24 | 85 | 11 | 21 | 20 | 21 | 12 | 18 |
| Golden Eagle | 14 | 18 | 25 | 12 | 5 | 18 | 5 | 4 | 9 | 19 | 3 | 28 |
| Bald Eagle | 25 | 14 | 13 | 8 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 |
| Turkey Vulture | 0 | 0 | 3 | 33 | 36 | 40 | 48 | 32 | 42 | 166 | 64 | 94 |
| Burrowing Owl | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | 0 | 3 | 2 |
| Short-eared Owl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| Long-eared Owl | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Great Horned Owl | 1 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 |



A red-tailed hawk perching in a greasewood. JS 5/93

Golden Eagles

Golden eagle nests in the vicinity of the refuge were monitored in 1993. Of the 31 eagle territories monitored, 21 (67 percent) were active; as indicated by the presence of adult birds in the immediate area. Sixteen (51 percent) of these nests were successful in fledgling at least one young bird. These 16 nests produced a total of 19 young for an average of 1.18 young per nest. Table XXXII summarizes eagle nest data compiled since 1940.

Golden Eagle production in the Harney Basin and elsewhere is apparently closely related to prey availability; specifically

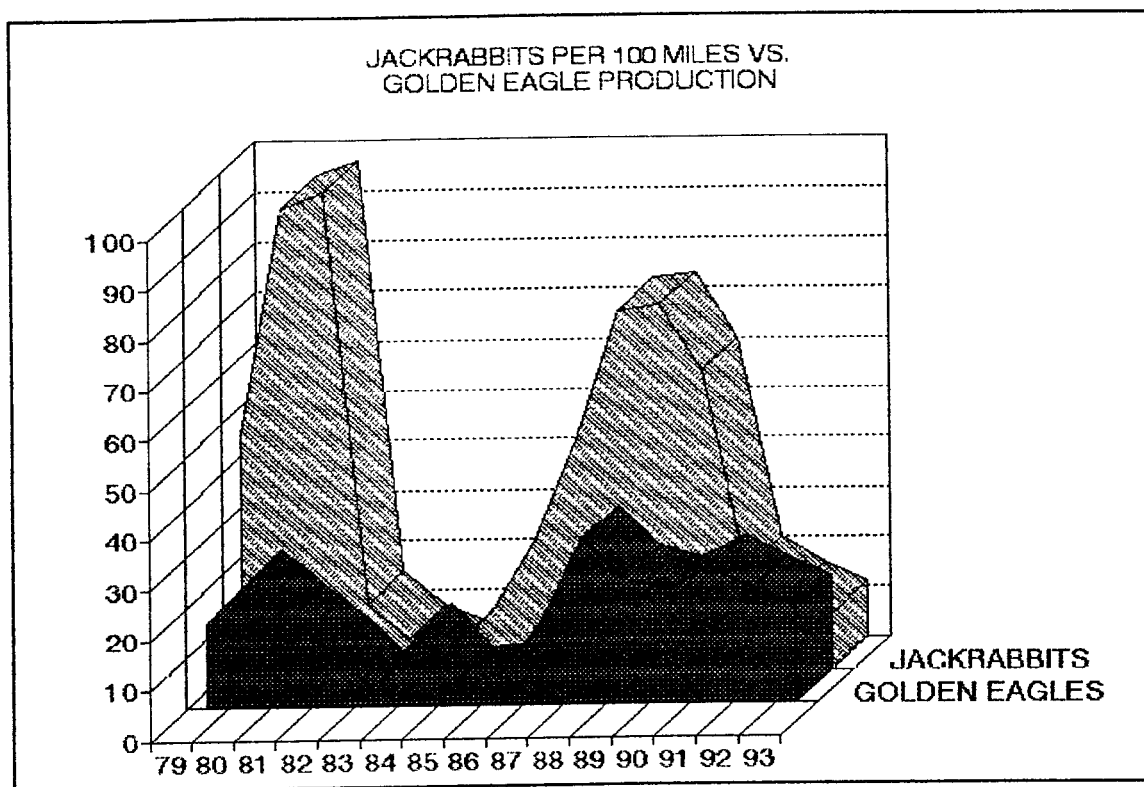
Table XXXII

Golden Eagle Production Summary 1940-1993

| YEAR | # FLEDGED PER TERRITORY n=sample size | | # FLEDGED PER SUCCESSFUL NEST n=sample size | | TOTAL # FLEDGED | % SUCCESSFUL NESTS n=sample size | |
|------|--|-------|--|-------|-----------------|-------------------------------------|-------|
| 1940 | 0.86 | n=7 | 1.50 | n=4 | 6 | 57 | n=7 |
| 1966 | 1.00 | n=6 | 1.50 | n=4 | 6 | 57 | n=7 |
| 1967 | 1.40 | n=10 | 1.75 | n=8 | 14 | 73 | n=11 |
| 1968 | 1.60 | n=5 | 2.00 | n=4 | 8 | 57 | n=7 |
| 1969 | 1.67 | n=6 | 1.67 | n=6 | 10 | 66 | n=9 |
| 1970 | 1.00 | n=8 | 1.60 | n=5 | 8 | 45 | n=11 |
| 1971 | 0.89 | n=9 | 2.00 | n=4 | 8 | 40 | n=10 |
| 1972 | 0.50 | n=10 | 1.67 | n=3 | 5 | 27 | n=11 |
| 1973 | 0.20 | n=10 | 2.00 | n=1 | 2 | 8 | n=13 |
| 1974 | 0.55 | n=11 | 2.00 | n=3 | 6 | 25 | n=12 |
| 1975 | -- | -- | -- | -- | -- | -- | -- |
| 1976 | 1.00 | n=8 | 1.60 | n=5 | 8 | 55 | n=9 |
| 1977 | 1.50 | n=8 | 2.00 | n=6 | 12 | 60 | n=10 |
| 1978 | 1.62 | n=13 | 1.75 | n=12 | 21 | 75 | n=16 |
| 1979 | 1.06 | n=16 | 1.42 | n=12 | 17 | 71 | n=17 |
| 1980 | 1.39 | n=18 | 1.67 | n=15 | 25 | 83 | n=18 |
| 1981 | 1.20 | n=18 | 1.38 | n=13 | 18 | 72 | n=18 |
| 1982 | 0.50 | n=22 | 1.57 | n=7 | 11 | 32 | n=22 |
| 1983 | 0.14 | n=21 | 1.50 | n=2 | 3 | 9 | n=22 |
| 1984 | 0.50 | n=28 | 1.40 | n=10 | 14 | 36 | n=28 |
| 1985 | 0.16 | n=28 | 1.17 | n=4 | 5 | 14 | n=28 |
| 1986 | 0.25 | n=24 | 1.50 | n=4 | 6 | 17 | n=24 |
| 1987 | 0.57 | n=30 | 1.42 | n=12 | 17 | 40 | n=30 |
| 1988 | 1.10 | n=30 | 1.65 | n=20 | 33 | 67 | n=30 |
| 1989 | 0.83 | n=30 | 1.39 | n=18 | 25 | 60 | n=30 |
| 1990 | 0.77 | n=30 | 1.53 | n=15 | 23 | 50 | n=30 |
| 1991 | 0.90 | n=30 | 1.50 | n=18 | 27 | 60 | n=30 |
| 1992 | 0.74 | n=31 | 1.77 | n=14 | 23 | 45 | n=31 |
| 1993 | 0.61 | n=31 | 1.18 | n=16 | 19 | 51 | n=31 |
| MEAN | 0.88 | n=498 | 1.62 | n=244 | 382 | 48% | n=521 |

to rabbit population levels. Black-tailed jackrabbits (*Lepus americanus*) provide an important prey base for golden eagles, hawks and owls. In addition, they serve as a buffer food for predatory birds and mammals that might otherwise prey on waterfowl, sandhill cranes and other species. Figure 14 illustrates the correlation between the number of jackrabbits observed per 100 miles and the number of golden eagles produced in the same area between 1979 and 1993.

Figure 14 Jackrabbits Observed Per 100 Miles and the Number of Golden Eagles Produced, 1979-1993.



7. Other Migratory Birds

Raptor Related Species

In addition to monitoring raptors, several other related species were counted while conducting raptor surveys. Data was collected from the 15 raptor survey routes in the Harney Basin. Table XXXIII summarizes non-raptor species counted from 1991 to 1993.

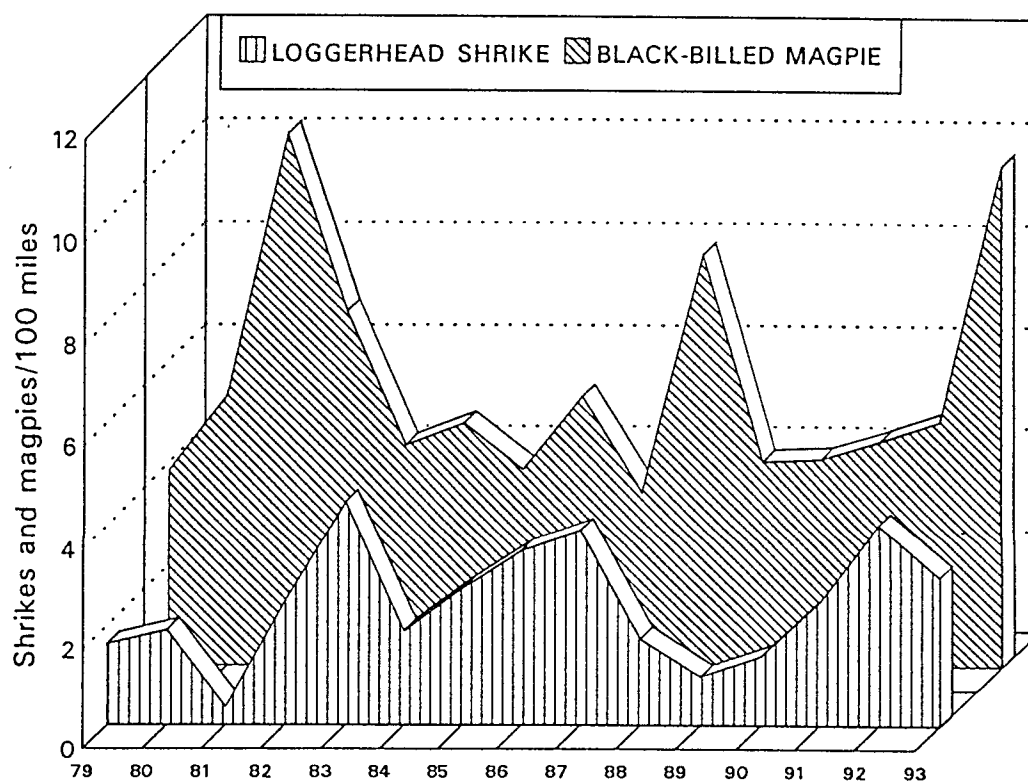
Table XXXIII Annual Summary of Raptor Related Species
Observed on Quarterly Counts in 1991-1993.

| SPECIES | WINTER | | | SPRING | | | SUMMER | | | FALL | | |
|-----------------|--------|--------|-----|--------|--------|-----|--------|--------|-----|--------|--------|-----|
| | 91--92 | 92--93 | 93 | 91--92 | 92--93 | 93 | 91--92 | 92--93 | 93 | 91--92 | 92--93 | 93 |
| Common Raven | 182 | 95 | 158 | 131 | 158 | 156 | 167 | 268 | 195 | 418 | 585 | 916 |
| American Crow | 1 | 0 | 0 | 8 | 19 | 63 | 73 | 33 | 26 | 643 | 59 | 95 |
| B.b magpie | 23 | 18 | 59 | 12 | 18 | 25 | 14 | 3 | 11 | 1 | 14 | 8 |
| Log. Shrike | 4 | 1 | 0 | 6 | 17 | 8 | 5 | 17 | 6 | 13 | 9 | 15 |
| Northern Shrike | 4 | 0 | 2 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 5 | 0 |

Magpie and shrikes

Black-billed magpies and loggerhead shrikes are counted during raptor counts in the Harney Basin. Figure 15 shows magpie and shrike data collected since 1979.

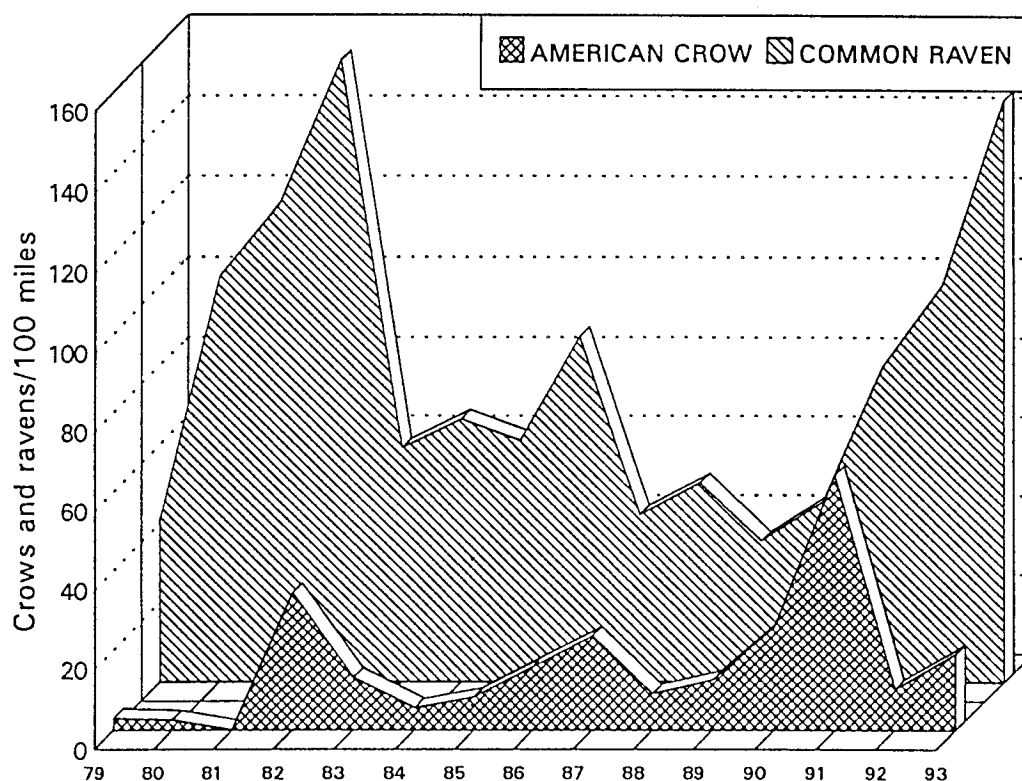
FIGURE 15 Shrikes and Magpies in the Harney Basin, 1979-1993.



Ravens and Crows

Common ravens and American crows are counted during raptor counts in the Harney Basin. Figure 16 shows raven and crow data collected since 1979. These birds appear to respond to changes in rabbit populations.

FIGURE 16 Crows and Ravens in the Harney Basin, 1979 - 1993.

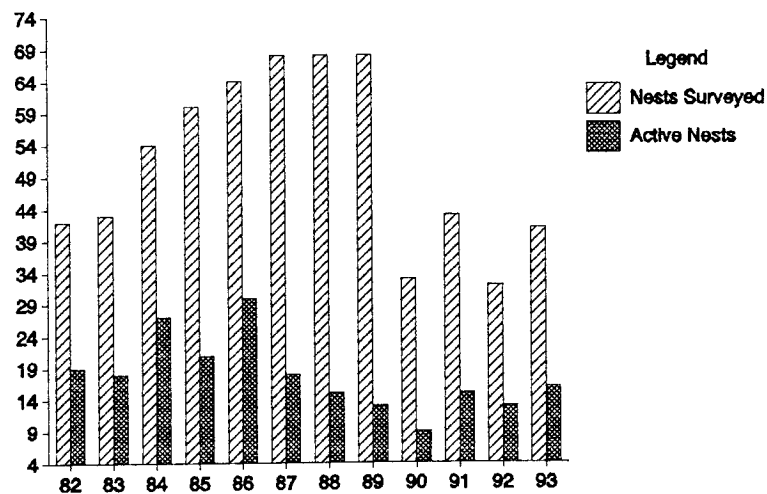


Raven Nesting

Common raven nests are monitored at Malheur Refuge to provide baseline data on the status of the species and to gather information useful in evaluating the effects of raven control. Ravens have been identified as key egg predators for refuge greater sandhill cranes, Canada geese, and other waterfowl. A total of 41 raven nests were monitored between March 1st and May 29th. Of these, 16 were active and none were located within the designated predator control area on the refuge. During 1992, 44 nests were monitored and 13 were active, two active nests were located within

the control area. A comparison between these two years indicates a 100 percent decrease in active raven nests within the control area and a 14 percent increase in the non-control area. The data indicates that the control program was effective in removing nesting ravens from the control area. Figure 17 illustrates raven nests on and adjacent to Malheur Refuge from 1982 to 1993.

Figure 17 Raven Nests On and Adjacent to Malheur Refuge 1982-1993.



Bobolinks

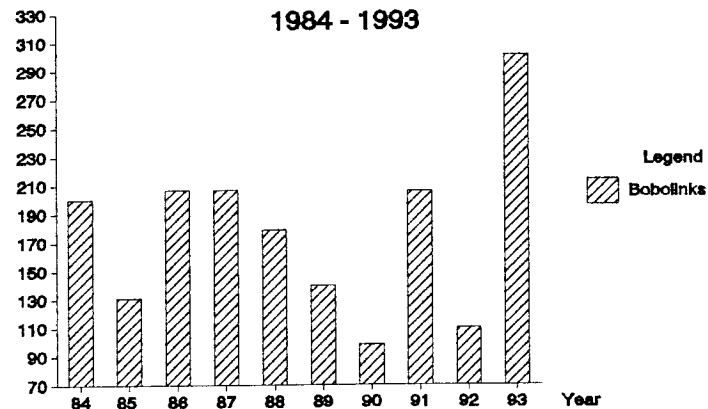
Bobolink surveys were conducted in early June and a total of 301 males were observed. This number is a 274 percent increase over the 1992 count (110) and a 146 percent increase over the 1991 count (206). Table XXXIV provides a summary of male bobolinks recorded by field from the 1993 survey. Figure 18 illustrates the number of male bobolinks recorded on the refuge between 1984 and 1993.

Table XXXIV Summary of Male Bobolinks by Refuge Field at Malheur Refuge in 1993.

| Field (Unit #) | No. Bobolinks | Field (Unit #) | No. Bobolinks |
|---------------------|---------------|---------------------|---------------|
| Horse Pasture (7) | 19 | North Meadow (12) | 19 |
| North Meadow (7) | 3 | W-South Meadow (12) | 54 |
| North Jones (11) | 10 | E-South Meadow (12) | 27 |
| South Jones (11) | 28 | Dry (12) | 0 |
| Faye (12) | 14 | Warm Springs (12) | 1 |
| Baker (12) | 38 | Barley (12) | 17 |
| Island (12) | 52 | E-Big Juniper (12) | 5 |
| Bridge Creek (12) | 0 | W-Big Juniper (12) | 11 |
| OVERALL TOTAL - 301 | | | |

Figure 18

Male Bobolinks from Transects on Malheur Refuge



Coyotes

Coyote scat surveys were initiated during the fall of 1987 as a way of evaluating the effects of the predator control program on relative coyote abundance. Three years later, a winter survey was added to provide an abundance index prior to the predator control season. Table XXXV provides a summary of coyotes removed and corresponding fall and winter abundance indices on Malheur Refuge for the years 1987 - 1993.

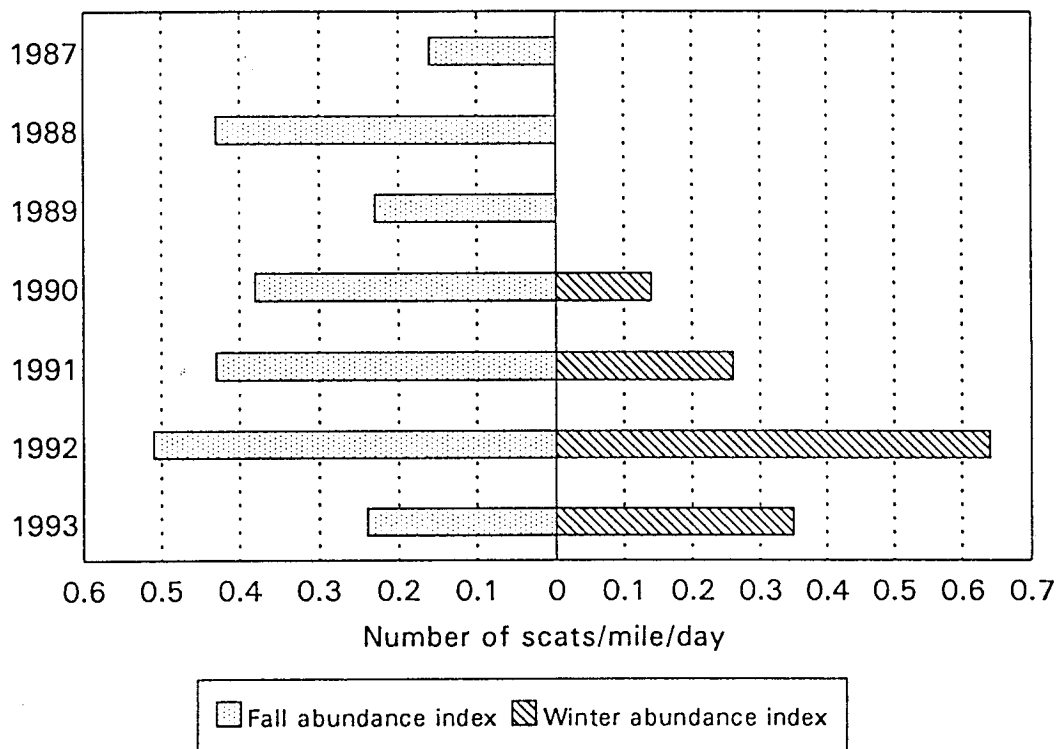
Table XXXV Numbers of Coyotes Removed and Corresponding
Fall and Winter Abundance Indices on Malheur
Refuge for the Years 1987-1993.

| YEAR | NO. OF COYOTES REMOVED | ABUNDANCE INDEX SCATS/MILE/DAY | |
|------|------------------------|--------------------------------|--------------|
| | | Fall (Sept) | Winter (Jan) |
| 1987 | 460 | 0.16 | _____ |
| 1988 | 226 | 0.43 | _____ |
| 1989 | 226 | 0.23 | _____ |
| 1990 | 137 | 0.38 | 0.14 |
| 1991 | 209 | 0.43 | 0.26 |
| 1992 | 228 | 0.51 | 0.64 |
| 1993 | 160 | 0.24 | 0.35 |

The 1993 fall and winter surveys indicate a decrease from the previous two years. The winter index decreased from .64 in 1992 to .35 in 1993, a 55 percent change, while the fall index decreased from .51 to .24 during the same time period, a 47 percent change.

The ODFW conducts a coyote survey for the entire county (Figure 19). Their index increased 240%, from 3.3 in 1992 to 8.0 in 1993. The data represent a one year lag in coyote abundance, because the index is calculated partially from data collected the previous year. The 1993 index is their highest since 1982, when the index was 8.9. While the index shows increases in coyote numbers, they were apparently widely scattered, possibly due to good water conditions in the county. Many factors play a role in monitoring coyote populations, including weather, floods, availability of prey, habitat changes, local movements on the refuge and movements outside of the control area. During this same period a total of 160 coyotes were removed from the refuge, 68 less than 1992.

Figure 19 Fall and Winter Abundance Indices of Coyotes Based on Scat Counts on Malheur Refuge, 1987-1993.



Winter surveys began in 1990.

Mink

The population of mink on the refuge has been high in recent years. In 1992, refuge biologists initiated a daytime predator observation survey, following the methodology used by the Northern Prairie Wildlife Research Center in Jamestown, North Dakota. The Northern Prairie Wildlife Research Center initiated this survey in 1983, and have used it on 33 study areas located in Canadian provinces of Alberta, Manitoba and Saskatchewan, and in Minnesota, Montana and North and South Dakota. Their data show indices of mink abundance ranging from zero to four. Malheur Refuge data for 1992 showed mink abundance ranging from 10 in the north Blitzen Valley, 13 in the Double-O, and 18 in the south Blitzen Valley. This

Valley than in any of the 33 Northern Prairie study areas. The local mink population apparently crashed during the winter and 1993 mink indices were as follows: 2.3 for the Double O area; 3.6 for north Blitzen Valley; and 0.5 for the south Blitzen Valley (where mink were included in the predator control program).

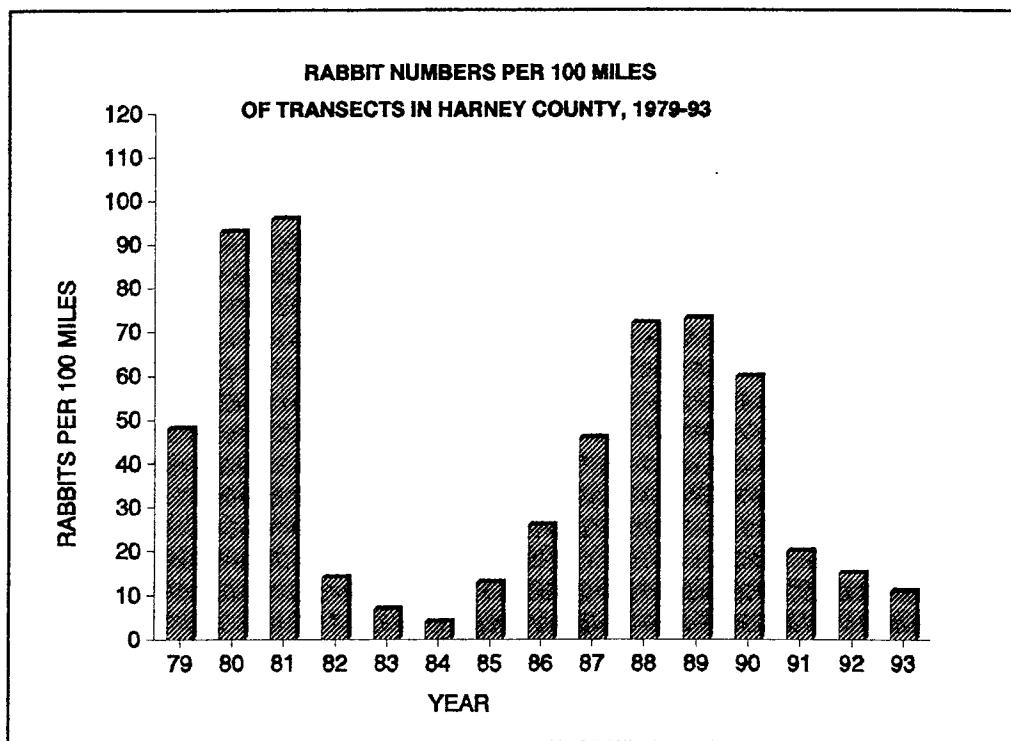
Muskrats

Because of severe winter conditions the annual muskrat house survey in January was not conducted. There has been a slow increase in the population since the mid-1980's flood destroyed all but a few of the 12,000 muskrat houses counted in the Blitzen Valley in 1978. A total of 14 muskrat houses were counted in 1992 and general observations since then indicate a slight increase. Historically, Malheur Lake has supported the highest percentage of muskrat houses on the refuge, however, the effects of the flood followed by a drought, continue to limit the reestablishment of emergent vegetation; preferred habitat for muskrats.

Rabbits

In an effort to document the relationship between golden eagles and black-tailed jackrabbits, rabbit surveys were conducted in January during the dark phase of the moon, thirty minutes after official sunset. Three transects, each eleven miles long were counted on three consecutive nights. All rabbits visible in high beam headlights were counted as the vehicle traveled through the transect at speeds between 15-20 mph. Rabbit numbers decreased slightly in 1993, following the population's apparent crash in 1991. Figure 20 displays rabbit survey data collected from the area since 1979.

FIGURE 20



8. Game Mammals

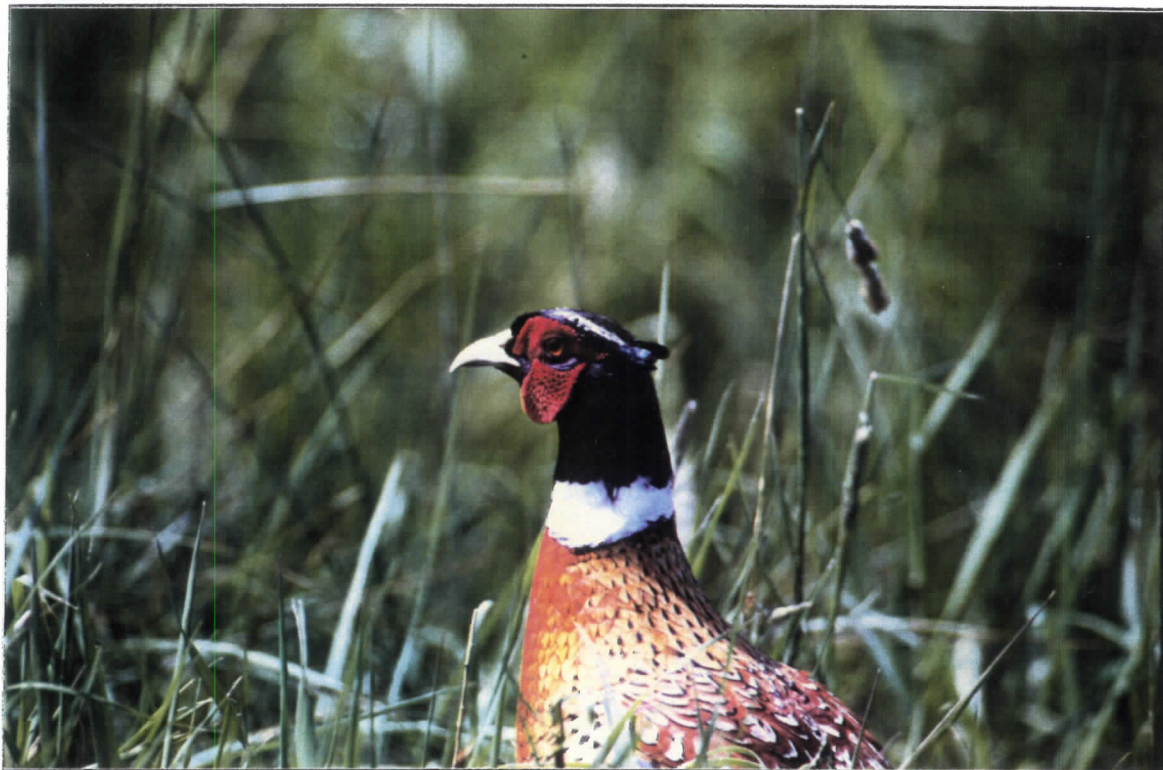
According to ODFW biologist Jim Lemos, big game species were severely impacted by the harsh 1992-1993 winter. Mule deer suffered the most with a decline of 25-50 percent from the previous winter. As a result of this decline the fawn drop in June was reduced to lower than normal levels. Elk numbers decreased slightly with most of the loss occurring among calves. Pronghorn antelope experienced a moderate decline of 15 percent from the previous year. Mule deer numbers were particularly high all year on the refuge, as deer were attracted to the shallower snow depths and better forage in the irrigated wetlands.

Elk sightings on the refuge continued to increase in 1993; elk were observed on the refuge on at least seven occasions. Most observations occurred in the spring, although several were observed throughout the summer on the wetlands associated with Malheur Lake.

10. Other Resident Wildlife

Upland Game Birds

Winter survival of chukar and California quail was poor because of snow depth and prolonged snow cover. However, sage grouse experienced only slight losses as a result of the severe winter. Production for sage grouse, California quail and chukar was also poor because of a wet spring. Brood counts for chukar were at their lowest number since the birds were introduced to the area. Refuge pheasant production was fair, in spite of the poor weather.



Ring Necked Pheasant RV 5/93

11. Fisheries

In August, 30 people from ODFW, the refuge fire crew, refuge staff and volunteers placed 120 feet of juniper rip-rap along a section of the Blitzen River. The rip-rap should stabilize the river bank and will eventually improve trout habitat along eroded sections of the bank between Page Springs Dam and the P Ranch. This was the sixth consecutive year the project has taken place, and past efforts have resulted in some real improvements in riverbank conditions.

CARP CONTROL PROGRAM

During 1992 an extensive carp control program was initiated to reduce the carp population on the refuge. (See the 1992 Narrative for more details) Refuge staff took advantage of historic low water levels related to the 6 year drought and were very successful in eliminating most of the carp using rotenone. The drought abated during the winter of 1992-1993, when above average precipitation occurred and limited the number of areas that could be effectively treated in 1993. However, several short stretches of canals, streams, and partially drained ponds were treated with rotenone when carp were observed. These areas included sections of Bridge Creek, West Canal, Center Canal, Five-Mile Spring and Cow-Pie Pond.

Draining ponds is another method of carp control, and several ponds were modified to allow for better drainage and to freeze carp during the winter. The water level in one large water impoundment, Carp Pond, was lowered substantially with the placement of a new drain. Some of the largest carp (16 lbs.) on the refuge were killed when part of the drainage ditch was cleaned by blasting with dynamite and subsequently drained.



Digging a ditch at Carp Pond to improve drainage. JO 1/93



Cleaning the Carp Pond drainage ditch using dynamite also eliminated large carp. JO 1/93



Some of the carp eliminated at Carp Pond weighed in at a whopping 16 pounds. JO 1/93



Everyone helped collect dead carp. JO 1/93

On July 26, 1993, wildlife biologist Rick Vetter met with Bruce King, a fisheries biologist with the Alaska Department of Fish and Game (ADFG) in Soldotna, Alaska, to gather information on fish wheels as a method of controlling carp on the refuge. Fish wheels were originally designed for catching salmon in coastal rivers, but with some modifications could aid in the control of carp.

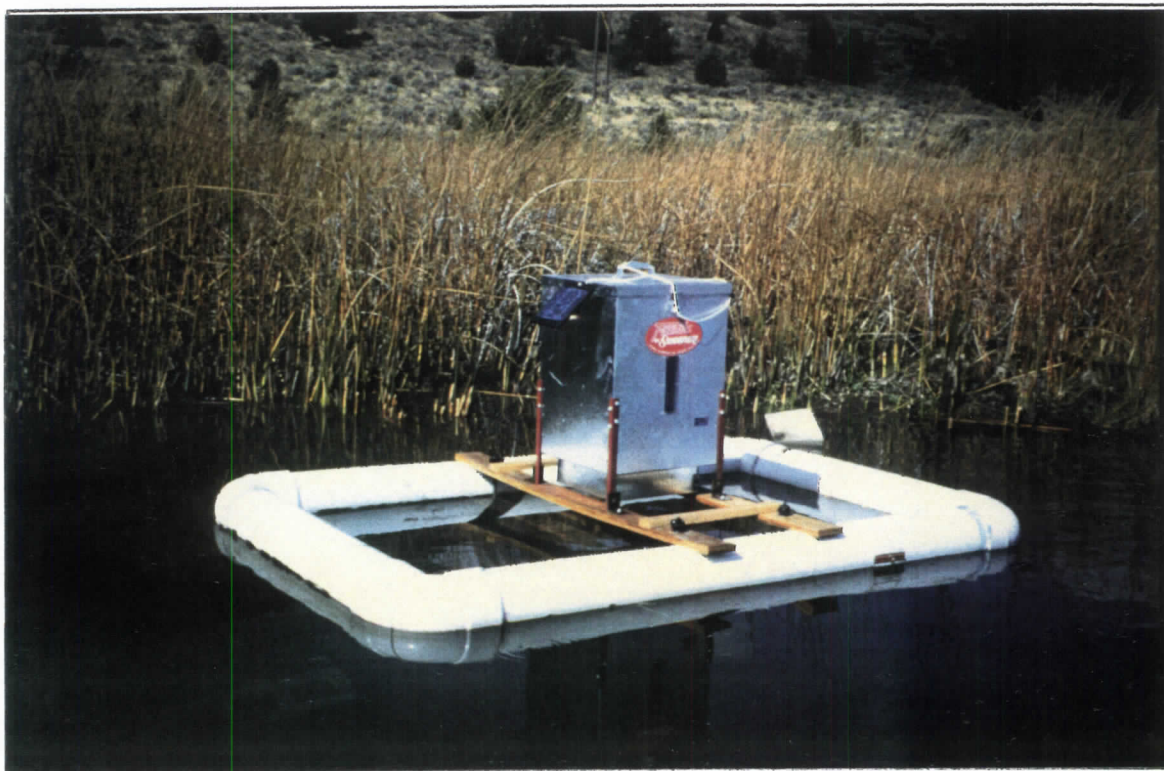
Fish wheels operate like small ferris-wheels, with 2-4 open ended cages positioned 180° across from each other. The axle is centered just above the water and as the river current pushes the back of one cage through the water, fish moving upstream swim into the open portion of the cage. This cage starts to rise out of the water and removes the fish from the river as the second cage enters the water and is pushed through in a similar manner. When each cage approaches its highest point of rotation the fish fall to the bottom of the cage and slide down a metal sheet that guides them into a live catch box. The basic design includes two half-open cages designed for fast flowing rivers with a velocity of 2-3 feet per second. Depending on the actual water velocity at each site, the wheels can be modified to control the rate of rotation through the water column. They can be mounted on permanent foundations or on barges.



One of the fish wheels used to collect in Alaska. RV 7/93

Since the goal of the refuge is to catch as many carp as possible, the fish wheel would be positioned in a narrow cement weir with minimal clearances on the sides and top. Any carp migrating upstream to spawn or towards warmer water in the winter would be removed from the system, whether it is in a canal or small stream. The addition of a live catch box would allow nontarget species to be returned to the stream.

The refuge is also testing a new fish management bait in conjunction with Auburn University. The technique uses a fish bait that has rotenone as the active ingredient. The rotenone will not leak out of the bait and kill fish in the water. The fish must consume the bait to be killed. Carp are attracted to a solar powered floating bait station that disperses dog food twice daily into the water. Once the carp develop a feeding behavior for the dog food the bait is switched with a similar dog food laced with rotenone. Tests conducted at Auburn University indicate one pellet will kill a 5 pound carp. We may also use the fish feeders to attract carp to traps.



Fish feeder being used to train carp to eat rotenone bait. RV 8/93

12. Wildlife Propagation and Stocking

Two different age classes of rainbow trout were stocked in Krumbo Reservoir this year. The reservoir received 39,950 fingerlings, at a ratio of 86 fish per pound, on May 26th. On May 28th, 4,991 catchable sized rainbow trout, at a ratio of three fish per pound, were released into the reservoir. The purpose of stocking is to reduce fishing pressure on wild trout and to provide recreational fishing opportunities.

In cooperation with the Oregon Department of Fish and Wildlife, 154 ringed-necked pheasants were trapped in January in the Blitzen Valley. The birds were released at the State's Summer Lake Wildlife Area in an effort to improve the genetics of their pheasant stock by using Malheur's hardy birds. This year's heavy snowfall and the long period of snow covered ground provided an excellent opportunity to bait and capture pheasants.

15. Animal Control

Predator Control to Enhance Greater Sandhill Crane Production

On November 25, 1985 the Fish and Wildlife Service (Service) issued a Final Environmental Assessment entitled (EA) "Alternatives to Enhance the Production of Greater Sandhill Cranes on Malheur Refuge, Oregon". This assessment, outlined a 21 percent decline in breeding pairs of sandhill cranes on Malheur National Wildlife Refuge from 1971 to 1985 (a decrease from 236 pairs to 186 pairs). The primary cause for this decline was low recruitment of young as a result of high nest predation by ravens, raccoons and coyotes, and high predation by coyotes on chicks before fledging. In an average year, predators destroyed 45 percent of all crane nests on the refuge and 85 percent of the chicks which hatched failed to fledged.

The EA proposed that efforts to improve sandhill crane nesting habitat continue and that coyotes, ravens and raccoons would be controlled for three years (1986-1988). The purposes of the control efforts were to: 1) increase sandhill crane nesting success to 75 percent, fledging success to 25 percent, and annual recruitment to a minimum of 15 percent on a sustained basis; 2) reach refuge production objectives of 150 crane chicks annually; and 3) reverse the current downward trend in the refuge crane population.

At the conclusion of three successful years of trial predator control, a new draft EA to extend the program was released on February 10, 1989 for public review and comment. The plan called for extension of the control program for an additional five-years to enhance the distressed refuge sandhill crane flock. It was approved by the Regional Director on March 29, 1989 and was to be conducted through the summer of 1993.

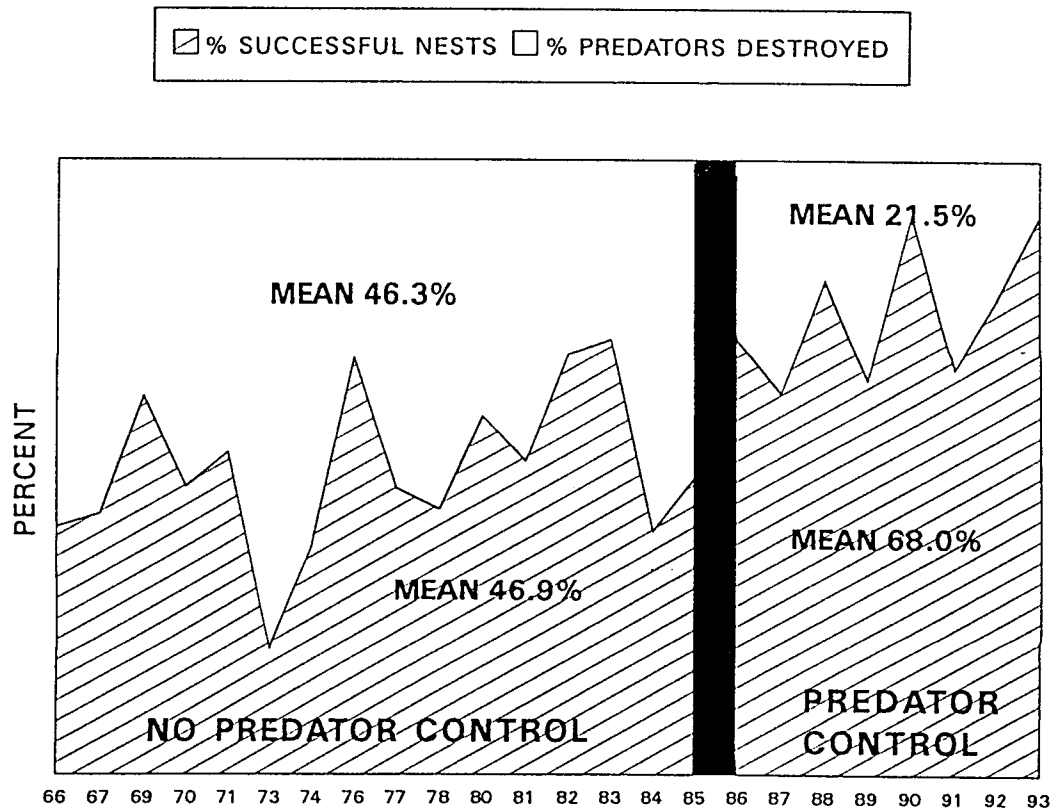
A radio-telemetry study in 1991 and 1992 showed that mink killed 35 or 36 percent of radioed crane colts. An amendment to the 1989 EA was proposed and approved. The amendment would add, on an experimental basis, mink to the control program in one-third of the control area. This included all of the refuge which lies south of Diamond Lane in the Blitzen Valley.

Costs of the program have averaged \$16,990 per year, and ranged from \$12,673 in 1986 to \$18,048 in 1993.

A total of 1,870 coyotes, 503 ravens, 113 raccoons, and 91 mink have been eliminated during the eight years of the program. An average of 233 coyotes were killed each year, ranging from 166 in 1990 to 460 in 1987. Forty-six non-target animals have also been killed in leg-hold traps.

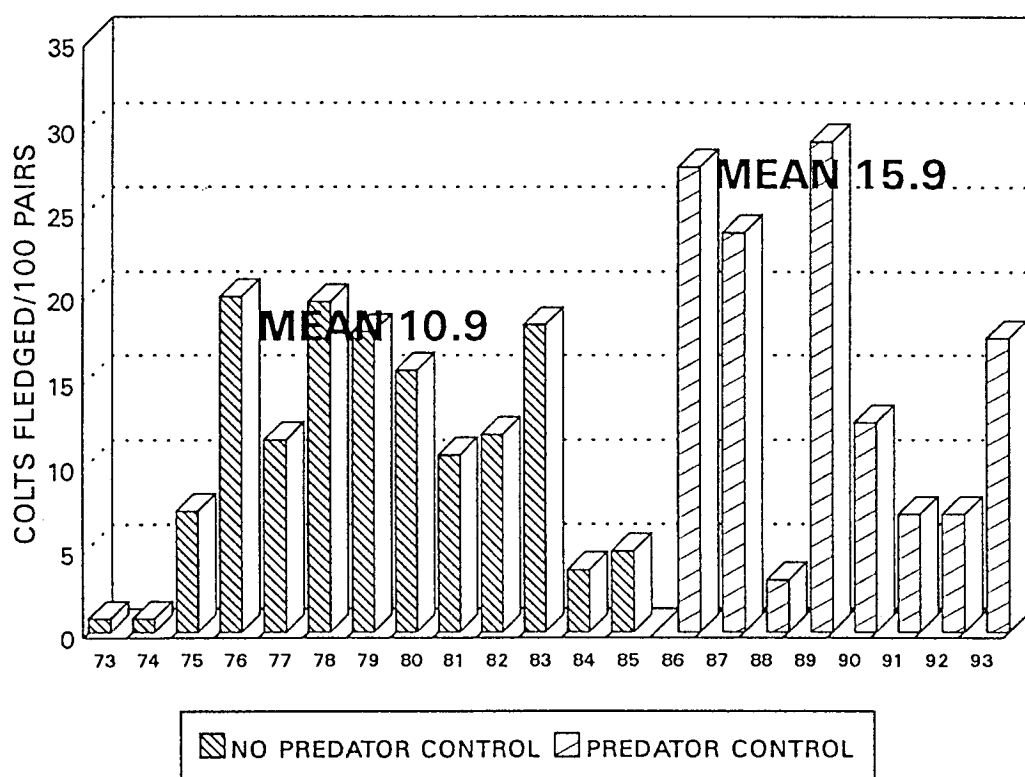
In general, the control program has been much more effective in increasing sandhill crane nest success than in improving brood survival. Over the eight years of the program, nest success has averaged 68 percent, compared to 47 percent before the control program (Figure 21). Predators have destroyed, on average, 21.5 percent of monitored crane nests during the control program, compared to 46 percent during years when predator control was not practiced. Unfortunately, colt survival has continued to be low and has ranged from six to 25 percent.

FIGURE 21 Fates of Sandhill Crane Nests Monitored at Malheur Refuge, 1966 - 1993.



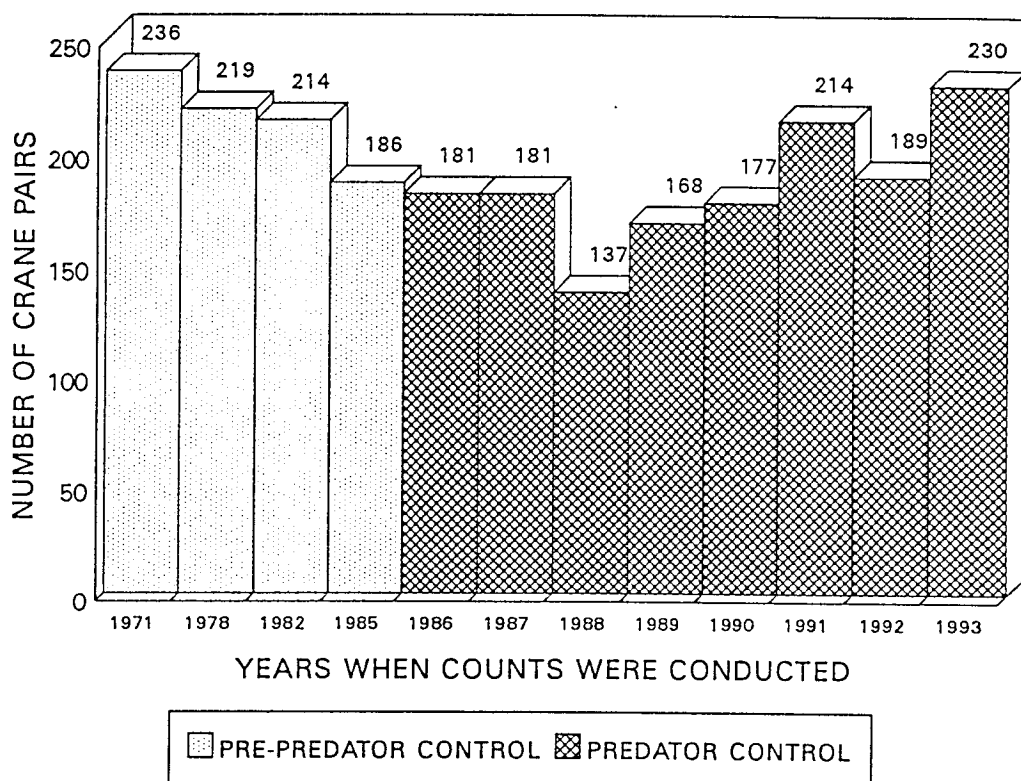
When compared to the non-predator control era, crane colt survival to fledging during predator management results in an average colt survival rate of 15.1 versus 9.8 percent, and average productivity of young per 100 pairs at 15.90 versus 11.0 percent (Figure 22). Although productivity for the program is not as high as expected, it has improved, despite extreme drought conditions which occurred during four of the eight years of the program.

FIGURE 22 Productivity of Sandhill Cranes at Malheur Refuge, Oregon, 1973 - 1993.



The best proof of the success of the program is the recovery of the refuge breeding population. The first crane breeding pair count was conducted in 1971, when 236 pairs were counted. Pairs were counted infrequently in the 1970's and early 1980's. Primarily because of low productivity, the number of breeding pairs declined to 186 by 1985, when the predator control program was recommended. Pair numbers continued to decline to a low of 137 in 1988 (probably an incomplete count) and began to increase in 1989, reaching 230 in 1993 (Figure 23). A reason for the lag in the increase of crane pairs is because they do not reach sexual maturity until they are 3-4 years old.

FIGURE 23 Number of Breeding Pairs of Sandhill Cranes Counted on Malheur Refuge, 1971 - 1993.



16. Marking and Banding

Table XXXVI summarizes waterfowl and other birds banded during 1993 at Malheur Refuge. Nine unfledged trumpeter swan cygnets and two molting non-breeders were transplanted to Summer Lake Wildlife Area during summer. Most of the 1361 ducks banded were captured by nightlighting from an airboat. This technique proved more efficient than baited traps, and a wide variety of local ducks were banded. Banding non-mallard ducks helped to meet goals established in recent years by the Pacific Flyway Council to improve data on waterfowl derivation in the Pacific Flyway.

Table XXXVI Summary of Birds Banded Under Malheur NWR
Permit #6270 in 1993.

| SPECIES | SEX/AGE | NUMBER BANDED |
|--------------------|---------|---------------|
| Mallard | AHY-M | 128 |
| Mallard | AHY-F | 157 |
| Mallard | L/HY-M | 30/41=71 |
| Mallard | L/HY-F | 50/34=84 |
| MALLARD TOTAL | ----- | 440 |
| Gadwall | ----- | 534 |
| C. Teal/unid. Teal | ----- | 64 |
| N. Pintail | ----- | 21 |
| A. Widgeon | ----- | 37 |
| N. Shoveler | ----- | 52 |
| Green-winged Teal | ----- | 10 |
| Wood Duck | ----- | 1 |
| Redhead | ----- | 196 |
| Canvasback | ----- | 4 |
| Ruddy Duck | ----- | 2 |
| TOTAL ALL DUCKS | | 1,361 |
| Trumpeter Swan | ----- | 13 |
| Canada Goose | ----- | 6 |
| Sandhill Crane | ----- | 16 |

17. Disease Prevention and Control

No disease losses were encountered on the Refuge in 1993. Cool summer temperatures probably prevented botulism from developing in the flooded areas around Malheur Lake.

H. PUBLIC USE

1. General

Total refuge visits appear to have increased over the previous two years. Wildlife observation, photography and other non-consumptive wildlife oriented activities continue to account for most refuge visits. Unlike previous years, visitor use did not decrease significantly after the spring migration ended. Perhaps the increase is because the refuge was featured in two regional magazines "Wild Birds" and "American Hunter" and in the "Seattle Sun" Newspaper. Table XXXVII summarizes refuge visitation for the last nine years.

Table XXXVII Estimated Visitation at Malheur Refuge.

| YEAR | VISITS |
|------|--------|
| 1985 | 22,080 |
| 1986 | 24,600 |
| 1987 | 39,670 |
| 1988 | 36,000 |
| 1989 | 43,200 |
| 1990 | 43,910 |
| 1991 | 43,050 |
| 1992 | 45,670 |
| 1993 | 48,500 |

Because Malheur Refuge is located in a remote area, public use facilities are extremely important for visitors. This year saw the development of new interpretive and comfort facilities at Buena Vista substation.

BLM's Steens Mountain National Recreation Area, with it's 66 mile National Scenic Byway, lies to the south of the refuge. Recreational use levels are monitored using car counters placed along the loop road entrances. According to BLM's data, 48,520 people visited Steens Mountain in 1993. The main access to Steens Mountain is through the refuge, so most of the visitors to Steens Mountain passed through the refuge. Because of weather constraints the National Scenic Byway was

only open this year from August to November. While most wildlife enthusiasts visit the refuge early in the season, the number of visitors passing through the refuge is probably much higher than indicated by Table XXXVII.

2. Outdoor Classroom - Students

Malheur Refuge was used extensively by elementary, high school and college students during 1993. This year refuge staff provided programs and slide show presentations about the refuge and the Service to visiting groups, and they guided several tours.

The Malheur Field Station, located on the refuge at an old Job Corps facility, operates under a cooperative site agreement with the Service and provides support services for education and research in the Great Basin. It is supported by a consortium of 26 universities, colleges and natural resource related organizations. Approximately 6,000 people used the Field Station's facilities in 1993.

5. Interpretive Tour Routes

In accordance with the Oregon High Desert Discovery plan, some interpretive development was installed in 1993. Work has started to update the Auto Tour brochure and new signs are being placed along the auto tour route.

6. Interpretive Exhibits and Demonstrations

Refuge headquarters continues to be a focal point for visits to the refuge. The Benson Memorial Museum contains nearly 200 mounted specimens of birds that been observed in the area. There has been a concerted effort to keep displays in the museum, as well as the newly remodelled main office lobby, changing on a seasonal basis. Contractual delays pushed the installation of new signs and exhibits for Buena Vista substation and at Headquarters to early 1994. During the year bases for new entrance signs and the Buena Vista Overlook exhibits were completed by refuge maintenance staff and fire crews.

7. Other Interpretive Programs

Of special note was a tour of the refuge for writers from the Outdoor Writers Association of America and an international group of geologists.

Other refuge programs were conducted for a variety of groups ranging from elementary school students to elderhostels. The refuge also hosted a portion of a workshop for local teachers.

Migratory Bird Festival

The Twelfth Annual John Scharff Migratory Bird Festival was held the first weekend in April. The festival coincides with spring waterfowl migration and has turned into one of the biggest birding events in the northwest, drawing hundreds of out-of-town visitors to the area. By providing guest speakers, tour guides, workshop leaders, slide shows, booths, wildlife art, a banquet and art auction and other activities the local community has turned this event into a fun packed three day birding ritual. This year's keynote speaker was Bill Thompson III, managing editor of "Bird Watcher's Digest".

Directions to the Past

After 8 months of planning, archaeologists from the refuge, the BLM and the Forest Service hosted a cultural resource fair called "Directions to the Past". The event was held April 21-25 at the Grant County Fairgrounds and April 29 through May 2 at the Harney County Fairgrounds. Refuge Archaeologists Carla Burnside and Jennifer Najera were on the celebration planning committee. The fair focussed on educating the public about resources found on federal land and the need to protect prehistoric and historic resources from vandalism. Resources emphasized during the fair included rock art, prehistoric structures, plants used by Native Americans, historic fire lookouts, the role of the Civilian Conservation Corps on federal lands, the history of timber technology, the role of Chinese immigrants in the northwest, the Oregon Trail, and historic tools. Traveling exhibits created by the Forest Service were central to the fair. Each of the local federal agencies also created exhibits about local history and prehistory. The Burns Paiute Tribe, a local Basque group, and ranching interests were also represented. This was a unique opportunity for the refuge to highlight it's historical development and prehistoric use of the marsh.

Because a major emphasis of the fair was education, special viewings of the Burns fair exhibits were scheduled for children from Harney and Malheur Counties. A busload of students traveled 100 miles from the McDermitt Indian Reservation in Nevada to view the Burns show. Approximately 2000 school children participated in the Burns fair. Students toured selected exhibits during their fieldtrip and presented passports for stamping. At each exhibit they were given an explanation of what the topic of the exhibit was all about. Archaeologists, Outdoor Recreation Planners, Botanists,

Biologists and other federal agency personnel staffed the booths. Besides the students an additional 3000 people attended the fair over the weekend.



Joel David stamps student's passports as they tour exhibits. MA 4/93



Outdoor Recreation Planner Doug Staller demonstrates how a harpoon was used for hunting, while a teacher signs for a deaf student. MA 4/93



Outdoor Recreation Planner Beth Ullenberg demonstrates historic tools at the "Whatzit?" booth as Archaeologist Jennifer Najera looks on. MA 4/93

Hunters were using the refuge during the entire waterfowl season. Lack of access continued to be the main limiting factor.

The portion of the refuge between Diamond and Sod House Lanes, known as the Buena Vista Area, was open to upland game hunting during the last fourteen days of the state pheasant season. On opening weekend, despite poor weather conditions, approximately 75 hunters used the area. Hunting pressure was greatest during the final weekend when over 150 hunters were on the area. Hunters were consistently present in the area throughout the season.

9. Fishing

Krumbo Reservoir, Bridge Creek, and the Blitzen River continue to provide enjoyable fishing opportunities for anglers. The predominant game fish was rainbow trout, which were stocked by the Oregon Department of Fish and Game, however, large-mouthed bass fishing seems to be growing in popularity. The two best months to fish for trout were May and October when cooler temperatures prevailed. During the warmer months, bass fisherman in float tubes and boats with electric motors were quite effective at fishing in the aquatic vegetation that takes over Krumbo Reservoir. In 1993 the refuge received a \$53,000 matching grant from the Oregon State Marine Board to develop accessible facilities at Krumbo. The proposal includes a paved trail, improved parking, a fishing pier, two restrooms, and a concrete launch ramp. Plans are currently being finalized with construction planned for 1994.

17. Law Enforcement

Law enforcement at Malheur is conducted by collateral duty officers Blacker and David and a full-time officer, Dan Sheill. Blacker, David, and Sheill attended law enforcement refresher training in February and March at FLETC in Marana, Arizona. Deputy Manager Walsworth instructed the Physical Efficiency Battery portion of both refresher sessions.

The law enforcement program received priority attention as a patrol vehicle was properly equipped; a patrol log system was initiated; miscellaneous equipment was ordered; and a Memorandum of Understanding for Cooperative Law Enforcement Efforts was signed with the Burns District BLM Office. Officer Sheill resigned in August to attend the Seattle Police Academy but returned in the winter to resume duties.

Refuge Officers patrolled in the spring and summer to detect artifact hunters and several citations were written under 16

USC 668dd; 50 CFR 27.62 "searching for or removing objects of antiquity." Special Agents Nylander and Harrington were involved in a multi-agency, undercover operation to detect and apprehend artifact collectors over the Memorial Day weekend.

Refuge Officers patrolled in the summer and fall to enforce fishing and hunting regulations. Approximately 200 people participated in the opening day of fishing season at Krumbo Reservoir. One person was cited later in the summer for fishing without a valid license. In the fall, 170 special use permits were issued to hunters to access Malheur Lake, and pheasant hunting in the Upper Blitzen Valley was popular.

In March, six Canada geese were found shot with their breast meat cut out. Two incidents of damage to government property occurred in the spring, as a new tractor and a shovel loader were used for rifle target practice in April and May. In May, a golden eagle carcass was found near a trapping site and is presumed to have been killed by an illegal bobcat trap. In May, a car at Krumbo Reservoir was broken into and a theft of \$250 occurred. In July, twelve avocets and other shorebirds were found shot on private property northeast of the refuge. During the fall hunting season, two deer gut piles were found on the refuge and information from various sources indicates that 10 to 12 deer were probably poached.

As public use continues to increase on the refuge, so does the need to protect the refuge from misuse. Area closures, nesting period restrictions, off-road motor vehicle use, vandalism, littering, camping, and fire restrictions continue to be areas of future emphasis.



Canada geese shot illegally in March had only their breast meat removed. DS 3/93



Golden eagle killed in an illegal bobcat trap. DS 5/93

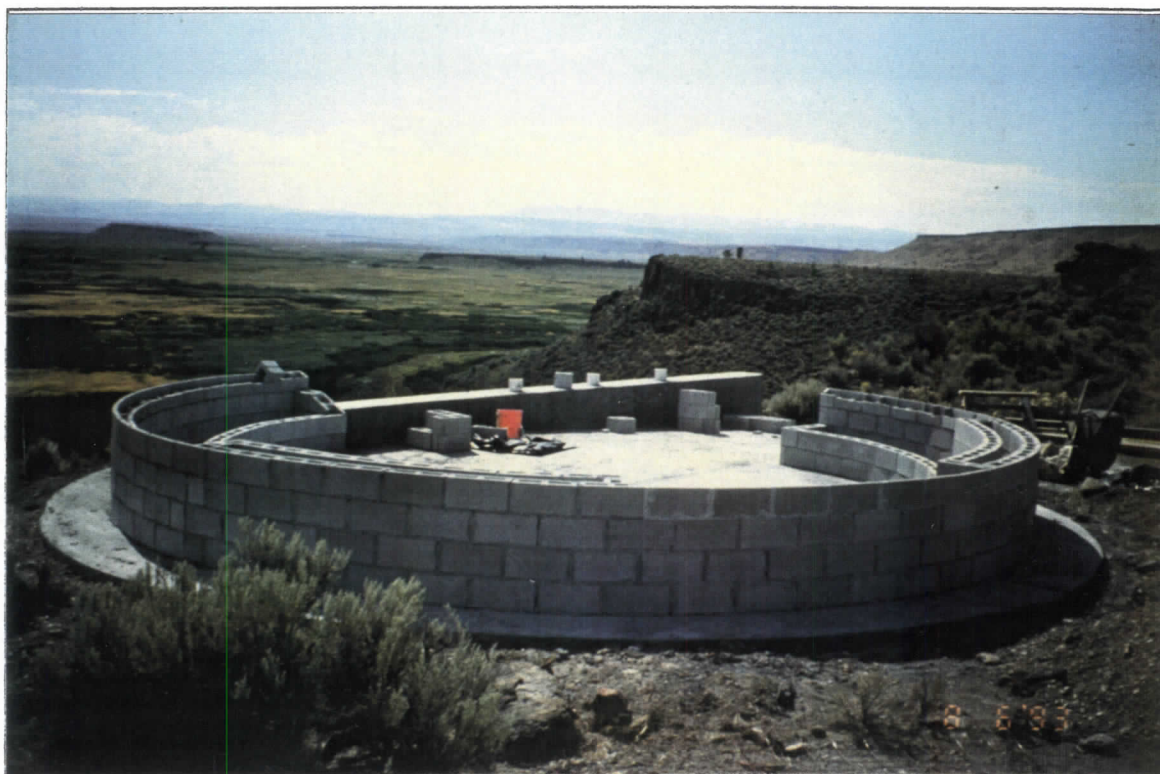
I. EQUIPMENT AND FACILITIES

1. New Construction

Fence construction has been a high priority at the refuge since the extensive flooding of the 1980's destroyed a significant portion of boundary fence especially on Malheur Lake. Establishment of refuge boundary fence is important as it tends to discourage archeological vandalism, and eliminates livestock trespass. These two problems have significantly affected our ability to adequately protect and manage our resources. A contractor from Lakeview, Oregon who had completed a 34 mile fencing contract in the fall of 1991 and spring of 1992 returned to build approximately 25 additional miles of fence along the southeast section of Harney Lake, in the Blitzen Valley between Webb and Knox Springs and around portions of Malheur Lake. By the end of the year, approximately 10 miles (of the 25 mile contract) had been constructed. The remainder is scheduled to be completed in the spring of 1994.

Construction on a variety of Partners for Wildlife Projects was initiated or completed in 1993. A 1991 project (Deguire) was completed with the installation of a water control structure which resulted in improved drainage and creation of a small pond. The 1992 BGHPW Farms, Inc. 60 acre wetland/brood pond was started in the fall. Completion of the project was not anticipated until 1994. Two 1993 projects were completed. The Webb and Houck projects both resulted in the creation of small ponds and wetland improvements.

Other major construction projects included installation of underground telephone lines to the service quarters at headquarters and removal of old poles. A vault toilet was installed at Buena Vista as part of the interpretive site development. Refuge personnel constructed bases for new entrance signs and interpretive panels at five locations: the entrance to Refuge Headquarters; on Highway 205 at Sodhouse Lane; at Buena Vista substation near the Vault toilet; on the Buena Vista Overlook site; and at Frenchglen. Water Control Structures were installed at McLaughlin Slough, S-curve along the Center Patrol Road, and the Double-O Entrance Road. A lift was purchased and installed in the new maintenance shop for working on 10,000 GVW or smaller vehicles. A 16 x 14 foot combination office/crew room/restroom was constructed inside the new maintenance shop. The shop also has storage space above the room. The interior of the new shop was wired for electricity and lighting was installed.



Buena Vista Overlook interpretive site under construction. 8/93 DS



Local stone mason working on the Buena Vista Overlook interpretive site. DS 10/93

A septic system project design was completed by the Regional Office engineering staff for systems at the P Ranch and Double-O substations, and for the new shop at headquarters. Components were purchased for these septic systems with installation planned for 1994.

2. Rehabilitation

The main office at refuge headquarters was remodelled to create more useable workspaces, while the reception area was enlarged to accommodate more visitors. As this was an intense remodelling project, our administrative staff was temporarily moved to the conference room. Relocation of the staff meant that work was completed without impacting the day-to-day operations of the office. A second entry door was added to the south end of the building to reduce staff foot traffic through the administrative area of the office. Once the remodelling was completed new systems workspace furniture was installed in the administration and biological offices. New heat pump/air conditioning units were also installed in the main office. Everyone who works in this building appreciated the new temperature control.

Other office improvements included installation of a new double sink, counter top, electrical outlets, and new plumbing fixtures in the archaeological lab area of the lower office.

Landscaping at Quarters 8, 9, and 14 was used to reduce dust in the buildings, reduce fire hazards and to improve the overall appearance of this part of headquarters. Initial work included blasting bedrock, levelling the ground surface, seeding, and mulching lawns, and fertilizing. A pole fence around each of the quarters lawns was completed. Shade trees were planted, drip lines installed, and protection against deer was added so the trees could get a head start. New gravel was added to the back entrance road and to driveways.

The engineering staff from the Regional Office completed an inspection of all refuge bridges. Three bridges, including structural beams, were rebuilt by Marv Jess and Jim Vanderdassen.



Carpenter Art Wittrock begins cutting rock for the new back door on the upper office. CB 10/93



Grain Camp bridge under reconstruction. 7/93

Water Delivery ditches were cleaned using the excavator at Krumbo, Hereford ditch, Nursery ditch, Sodhouse area, "OO" Spring, Big Deer Park, and Page Dam. Many miles of ditch were cleaned this year using this new piece of very efficient equipment. The excavator will enhance our maintenance program for years to come.

Willows were removed on one side of the southern portion of the Center Patrol Road to improve water flow for irrigation. A balance must be struck between the value of the habitat provided by the willows and an efficient and effective water delivery system for refuge wetlands. Timely delivery of water to wetlands is vital to waterfowl production and brood survival.

Many of the pipes and risers which control water levels or drains were deteriorated beyond economic repair or functional use. A concentrated effort this year replaced many of these structures improving our ability to irrigate wetlands, fill ponds, and control carp movement.

During the flood years many dikes were washed out or lost stability from wave erosion. Many loads of fill material and rip rap were placed on dikes. Dike repair concentrated on a backlog of work from the flood of 1992.

Refuge roads were graded and shaped and improved by adding rock from several different sources. Refuge roads provide the main opportunity for the public to view wildlife, so road conditions are important to the quality we can provide for our visitor's recreational experience. We will continue to upgrade our road conditions in the years ahead. We want to provide wider, safer roads and pullouts for wildlife observation.

3. Major Maintenance

Three hundred acres in five different fields were planted with barley and winter wheat. This grain provides an important fall food source for staging sandhill cranes.

With limited equipment a mowing program was established in 1993. Mowing provides access to areas during dry season while reducing fire danger. Mowing provides a varied level of cover along roadsides, while improving visibility for visitors along the primary public travel routes and it also helps control noxious weeds.

With the help of the YCC and seasonal fire crews the lawns at headquarters were well maintained. Trees and shrubbery were trimmed and flower beds were properly cared for. We are fortunate to benefit from the efforts of earlier refuge residents who helped establish our headquarters flora. Today these plants flourish and are used by neotropical migrants.

The headquarters offices and shop buildings were painted by local contractors. An effort was made to match the paint colors used on the historic buildings.

Greater emphasis was placed on annual maintenance of heavy equipment. An intense program was initiated to fully service major heavy equipment.

Other miscellaneous projects include replacement of a new outlet pipe at Carp Pond. The outlet structure was completely deteriorated, too small and did not drain properly. A larger pipe was installed at a lower elevation. The old diesel tank at headquarters was with a double walled "convault". Placed on a concrete slab, the convault meets requirements for leakage and spillage control. New convaults were installed at P-Ranch to replace older gravity diesel and gasoline tanks. Gravel hauling at Double-O improved the north road and the road to the Stinking Lake RNA. The installation of pipes improved the road into the Double-O substation. Gravel work was started on Rockford lane, but the weather hampered progress. Improvements to the southern portion of the Center Patrol Road were made with placement of many loads of gravel.

4. Equipment Utilization and Replacement

Replacement vehicles and new equipment included two pickup trucks, a Case 5140 tractor, a Case 9230 tractor, a Motrim mower, Kewanee plow disk, a surplused military trailer, and a belly-dump trailer. A Caterpillar EL 240 B excavator was leased early in the year.

Our maintenance staff and seasonal fire crews logged over six thousand hours on our new and old heavy equipment.

| | Make | Model | Acq. Date | Est. Hours |
|-----------|--------------------------|---------|-----------|------------|
| Dozers | Caterpillar | D-8 | 1952 | 20 |
| | Caterpillar | D-4 | 1954 | 100 |
| | Caterpillar | D-4 | 1963 | 125 |
| | Alice Chlmrs | HD-16M | 1977 | 225 |
| | John Deere | JD-750 | 1983 | 175 |
| Graders | Champion | N/A | 1989 | 250 |
| | Gallion | T500A | 1966 | 75 |
| Cranes | Koehring | ZMN66 | 1968 | 300 |
| | Bay City | 150+140 | 1953 | 200 |
| Draglines | Koehring | 304 | 1944 | 200 |
| | Koehring | 440 | 1980 | 300 |
| Forklift | Silent Hoist & Crane Co. | | | 40 |
| | Hyster | | | |

| | Make | Model | Acq. Date | Est. Hours |
|---------------------------|--------------------|---------|-----------|------------|
| Backhoes | John Deere | | 1987 | 300 |
| | Ford | 44014E | 1974 | 100 |
| Excavator | Caterpillar | | 1992 | 200 |
| Loader | Michigan | 85AM | 1960 | 300 |
| Tractors | John Deere | 2950 | 1985 | 150 |
| | Case | 5140 | 1993 | 200 |
| | Case | 9230 | 1993 | 200 |
| Scrapers | Bucyrus Erie | | 1964 | 200 |
| | Caterpillar | 623E | 1992 | 120 |
| Trailers | Pioneer | 40T | 1972 | 175 |
| | Fuel | | 1975 | 200 |
| | Horse | | 1986 | 60 |
| | Trailmax | TD-40-T | | 400 |
| Dump Trucks | IHC | 70-1700 | 1970 | 100 |
| | IHC | D1750 | 1981 | 100 |
| | Ford | U90 | 1991 | 400 |
| Flatbed Truck | Ford | F600 | 1968 | 200 |
| Farming Implements | | | | |
| | Ditcher | D-6 | 1973 | 40 |
| | Grain Drill | LLA | 1964 | 80 |
| | Harrow Disk | 29 | 1956 | 0 |
| | IHC Mower | 200 | 1990 | 160 |
| | Bush Mower | 257 | 1985 | 160 |
| | Bush Mower | SM-60 | 1985 | 200 |
| | JD Plow | 3100 | 1973 | 60 |
| | JD Rake | 258 | 1988 | 0 |
| | New Holland Ripper | | 1959 | 0 |
| | CAT Roller | 144 | 1971 | 40 |
| | Danuser Auger | F-8 | 1979 | 20 |

TOTAL HOURS ALL EQUIPMENT
6,175

J. OTHER ITEMS

1. Cooperative Programs

Trumpeter Swan Project

For the past few years, Biologist Gary Ivey has worked cooperatively with ODFW on a project aimed at improving Oregon's trumpeter swan flock. This project has two goals. The first is to teach the trumpeters of the Malheur flock to migrate to a more favorable wintering area, thereby reducing winter mortality. The second goal is to establish at least two new breeding flocks at other significant wetland sites in central and eastern Oregon.

The 18,000 acre Summer Lake Wildlife Area was designated as the most appropriate wintering area for Malheur's trumpeters. This area is managed by ODFW and is located about 80 miles west of Malheur Refuge. Summer Lake contains both excellent wintering and breeding habitat for trumpeter swans and was also chosen as a future breeding site. In addition to Summer Lake, the feasibility of establishing a breeding flock at Klamath Marsh National Wildlife Refuge has been investigated. Klamath Marsh Refuge was recently expanded to include about 30,000 acres and has the potential to support excellent trumpeter breeding habitat.

The swan project was begun in July 1991, when four non-breeding trumpeters from Red Rock Lakes National Wildlife Refuge were captured and transplanted to Malheur Refuge. Two non-breeders from Malheur were also moved to Summer Lake. The Red Rock Lakes birds were brought in to enhance the genetic makeup of the Malheur flock and as insurance against a decline in the flock in the event that the birds moved to Summer Lake did not return. In 1992, 26 subadult and 26 cygnets from Red Rock Lakes Refuge, plus four subadults from Malheur, were moved to Summer Lake during the summer. In 1993, two subadults and nine unfledged cygnets were moved from Malheur to Summer Lake.

As a result of the swan plan Summer Lake was selected by the Rocky Mountain Trumpeter Swan Study Committee as a site to transplant wintering birds from the Henry's Fork of the Snake River. This action was undertaken to prevent future trumpeter swan losses on this over utilized, traditional swan wintering area. During late November 1991, Biologist Ivey assisted ODFW personnel with the transportation of 100 trumpeters to Summer Lake. This effort was repeated in 1992 and 1993, with 101 and 152 trumpeter swans moved from the Henry's Fork to Summer Lake.

Pheasant Transplant Project

In 1991 a program of winter trapping of refuge pheasants was begun for ODFW. These birds are used to enhance the genetic stock of pheasants on the Summer Lake Wildlife Area. Heavy snowfall contributed to a successful project in 1993. During January and February, a total of 145 pheasants were transported to and released at Summer Lake. An additional nine birds were released on a Partner's For Wildlife project site.

3. Items of Interest

Archaeological Program

The recovery of vegetation on some islands of Malheur Lake contributed to decreased erosion of archaeological sites. Refuge archaeologists continued to monitor the condition of sites, but were able to spend more time working in other parts of the refuge. Evidence indicating that lake sites were still being looted was apparent in the spring, but decreased slightly as vegetation began to obscure portions of some sites. Collection and mapping of surface artifacts continued at vulnerable sites. For the first time in five years no human burials were exposed by erosional processes.

With a decreased emphasis on Malheur Lake sites the archaeological staff was able to focus their attention on some of the 200 other archaeological sites on the refuge. As many of these sites were last visited in the early 1970's, surveys of these sites and preparation of new site maps and new descriptions was initiated. Sites in the Boca Lake area were selected for the first phase of survey as they lie in a remote area of the refuge and have been subjected to looting. Two large stone ring village sites were identified near Boca Lake and a decision was made to conduct full scale mapping of the largest site. Although portions of the sites have been disturbed by roads, cattle grazing and rangeland discing it was apparent that both sites contained important information about prehistoric use of the east Blitzen Valley. Excavation units were placed in two stone rings to gain an understanding of what they might contain and if possible to collect enough charcoal to date the rings. Charcoal samples associated with projectile points were submitted for each stone ring and fairly recent dates of 150 and 350 years were obtained.



Refuge Archaeologist Jennifer Najera and SCA's Sue Shutty and Josh Hinson excavate a unit in a stone ring at Boca Lake. 7/93 CB

Archaeological sites associated with three springs (Hogwallow, Knox and Webb springs) in the Blitzen Valley were also examined. Excavations in 1973 at Hogwallow Spring indicated that the site was in use from 150 to 5000 years ago. Making this one of the oldest known sites on the refuge. Surface artifacts recorded near Knox Spring also indicate that the site is probably of considerable antiquity. A rock art site, generally interpreted as having ceremonial significance, is situated on the refuge near Webb Springs. Although the spring heads at Hogwallow and Knox are fenced to keep cattle out, archaeological sites surrounding the springs were being impacted by cattle from adjacent BLM allotments. A decision was made to place fences along the refuge boundary to prevent further damage to the sites.

Test excavations were also conducted at the Headquarters Site (35HA403) south of the old shop building. Tentative plans to construct a covered parking area between the old shop and the warehouse buildings would result in some disturbance to the hillside south of the maintenance yard. Two test units were put in on the hillside to determine the nature and extent of archaeological material in the area. Artifacts recovered from the test units are currently undergoing analyses.



ORP Beth Ullenberg helps Archaeologist Jennifer Najera excavate a unit at Headquarters. CB 7/93

The archaeological staff had a lot of help with the excavation of these units. The YCC crew assisted with screening dirt from the units, the outdoor recreation staff got to try their hand at excavation and several volunteers helped with other parts of the project.

A small collection of human bones were reburied in the fall. Some of these bones were recovered during contract archaeological excavations, however one cranium from Roaring Springs cave, removed in the 1930's, and another cranium that had been in the local high school biology lab were also interred. Since the reburial site was blessed in October 1992, the Burns Paiute Tribe did not feel that an additional ceremony was needed for these bones, so the archaeological staff, with the assistance of the outdoor recreation staff, reburied the remains.

As the critical situation on the lakes eases more time has been spent evaluating the condition of historic structures at the refuge. A Challenge Cost share grant between the Service and the Oregon Historical Society was developed for the Sodhouse Ranch Long Barn. A remnant of Peter French's ranching empire and part of the National Register of Historic Places Sodhouse Ranch, the barn leans dramatically to the east as a result of saturated soil and removal of some support posts. With the assistance of the Historical Society an architectural engineering plan will be developed for the barn. The Historical Society will also help solicit volunteer labor

to stabilize the barn. Discussions are already underway to assess the feasibility of developing the ranch into a living history facility.

4. Credits

Author Credits

| | |
|-----------------|--|
| Rod Blacker | F9 |
| Carla Burnside | A, D4, D5, E1, E3, E7, J1, J3, J4, Editing, Compilation |
| Forrest Cameron | E5, C1, Editing |
| Joel David | B, D2, E6, F1, F4-8, F15 |
| Gary Ivey | D5, E7, F2, G3-5, G15, J1 |
| Gretchen Lech | Various Graphics |
| Doug Staller | D3, H1, H2, H5-9 |
| Beth Ullenberg | E2-4 |
| Rick Vetter | F10, G1-2, G6-8, G10-12, G17 |
| Dan Walsworth | D1, H17, I1-4, I7 |
| Jack Richardson | F11 |

Photo Credits

| | |
|----|-----------------|
| MA | Mark Armstrong |
| BU | Beth Ullenberg |
| CB | Carla Burnside |
| DS | Doug Staller |
| DW | Dan Walsworth |
| FC | Forrest Cameron |
| GI | Gary Ivey |
| JD | Joel David |
| JN | Jennifer Najera |
| JO | John O'Connor |
| JS | Joan Suther |
| KH | Keith Henstock |
| RV | Rick Vetter |

K. FEEDBACK

Jack Richardson retires January 1, 1994. At this writing, funding for a replacement has not been provided. We are concerned whether the work on water rights which he began will be continued. Jack made a good start initiating the refuge's water rights program. But much remains to be done and we are dubious whether this can be accomplished efficiently from the water rights office in the Regional Office. We don't think that water rights work at Malheur is the type of duty that can simply be added to the role of an existing staff member. At least for these initial years of getting back on track a hydrological technician position, in our opinion, would be well worth the investment.